2021 Upper East Coast Water Supply Plan Update

Welcome

2021 UEC Technical Methods Workshop

July 16, 2021

Workshop Agenda

- Welcome and Introduction – Tom Colios, Section Leader
- East Coast Floridan Model – Rob Earle, Lead Modeler
  - Model overview
  - Model updates since 2014
  - UEC planning model scenarios and results
  - Modeling conclusions
- Public Comments and Questions
- Next Steps – Nancy Demonstranti, UEC Plan Manager

Introduction

- Water supply plans
  - Road map to meet future demands while protecting water resources and natural systems
  - Planning-level analysis to determine water supply availability
  - Summary of modeling results
- Regional groundwater models
  - Regional evaluation of groundwater resources
  - Specific to an area and aquifer system
  - Used for determining regional trends, not for local analysis
  - Separate technical document for detailed model updates, calibration, and results

East Coast Floridan Modeling to Support the 2021 Upper East Coast Water Supply Plan Update

Fort Pierce, FL

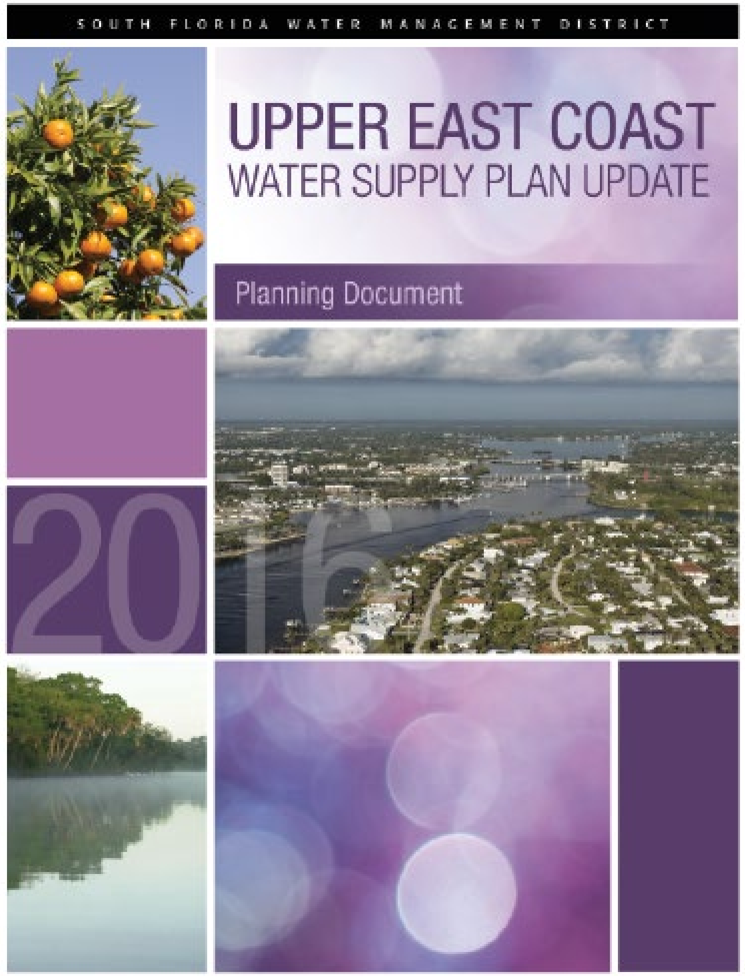
Rob Earle

Lead Modeler, Groundwater Modeling Unit, Water Supply Bureau

South Florida Water Management District

2016 Upper East Coast Water Supply Plan Update
Future Direction

- The surficial aquifer system (SAS) use is limited
  - Increases in water use expected to be supported by the Floridan aquifer system (FAS)
  - Brackish water from the FAS can serve as a supplemental agricultural water source
- Maintain wells critical to long-term monitoring and modeling
- New Avon Park permeable zone wellfields should have greater spacing and lower per-well capacity



SOUTH FLORIDA WATER MANAGEMENT DISTRICT

UPPER EAST COAST
WATER SUPPLY PLAN UPDATE

Planning Document

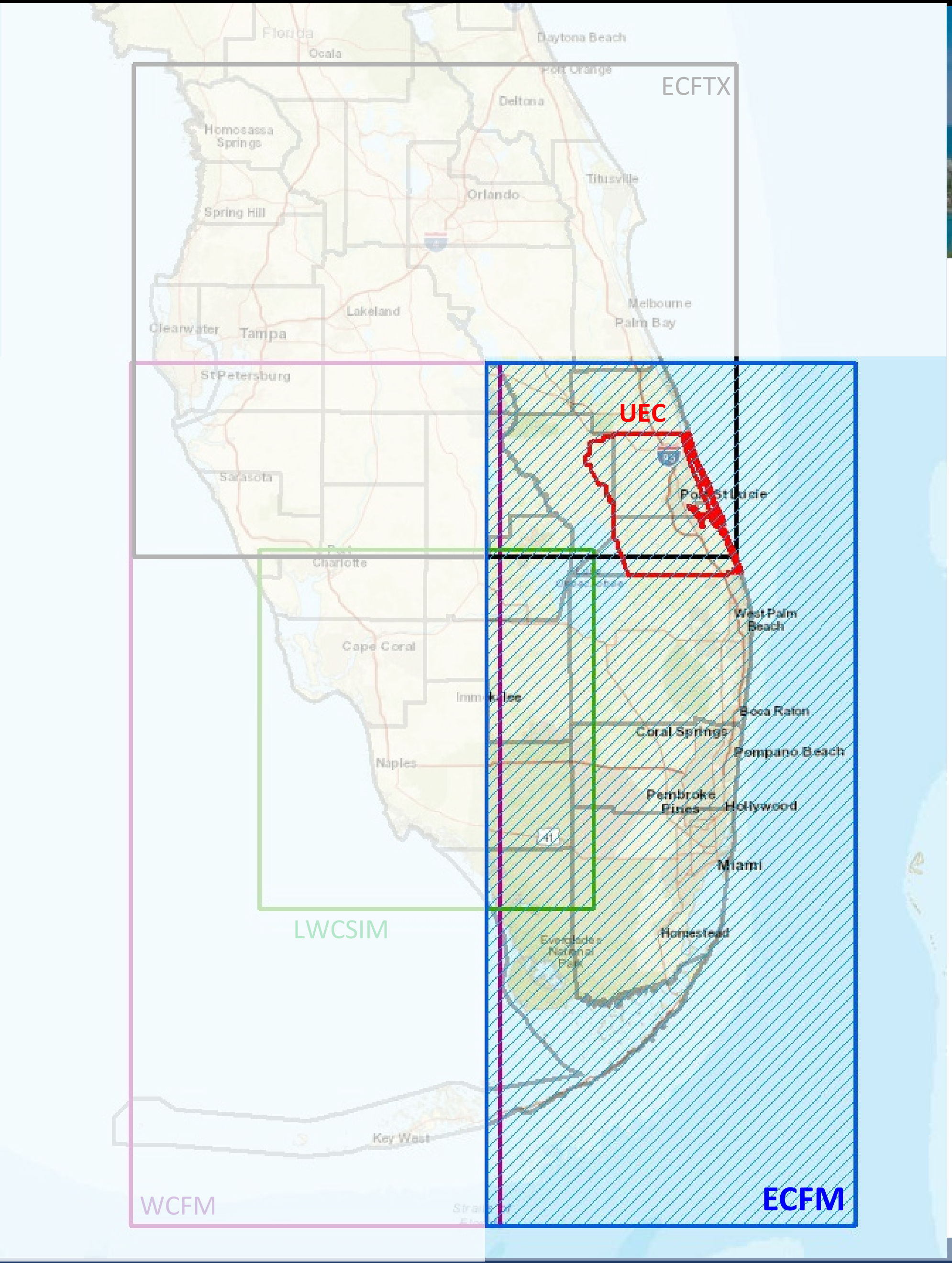
2016

East Coast Floridan Model Re-Calibration and Application to the Upper East Coast

Presentation Overview

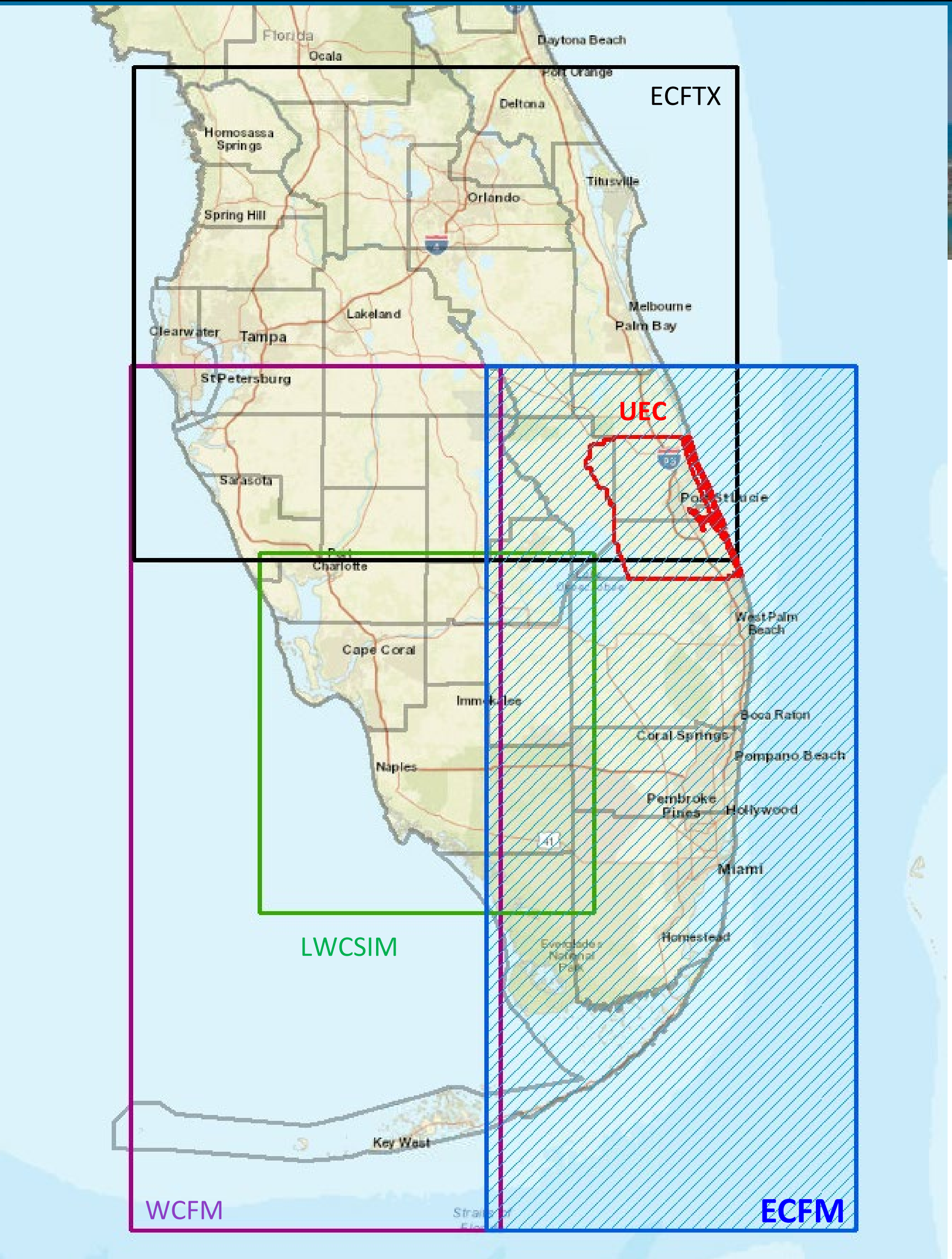
- East Coast Floridan Model overview
- East Coast Floridan Model re-calibration
- Application to Upper East Coast planning scenarios
- Upper East Coast planning scenario results

East Coast Floridan Model



Boundaries

- ➢ Brevard County (north)
- ➢ Florida Keys/Florida Straits (south)
- ➢ Atlantic Ocean (east)
- ➢ West Coast Floridan Model (west)

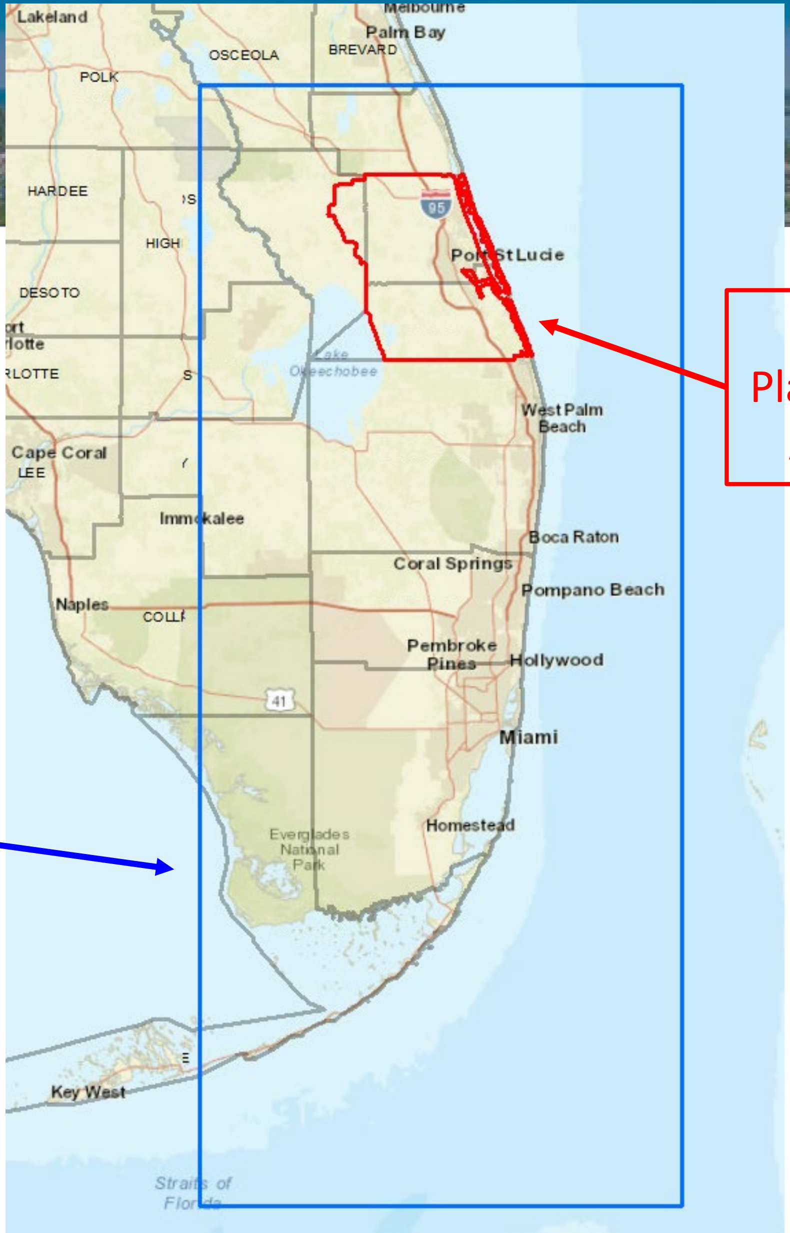


East Coast Floridan Model

- ➢ Northwestern portion of model domain overlaps the East-Central Florida Transient Expanded (ECFTX) Model
- ➢ Western portion of model domain slightly overlaps the West Coast Floridan Model

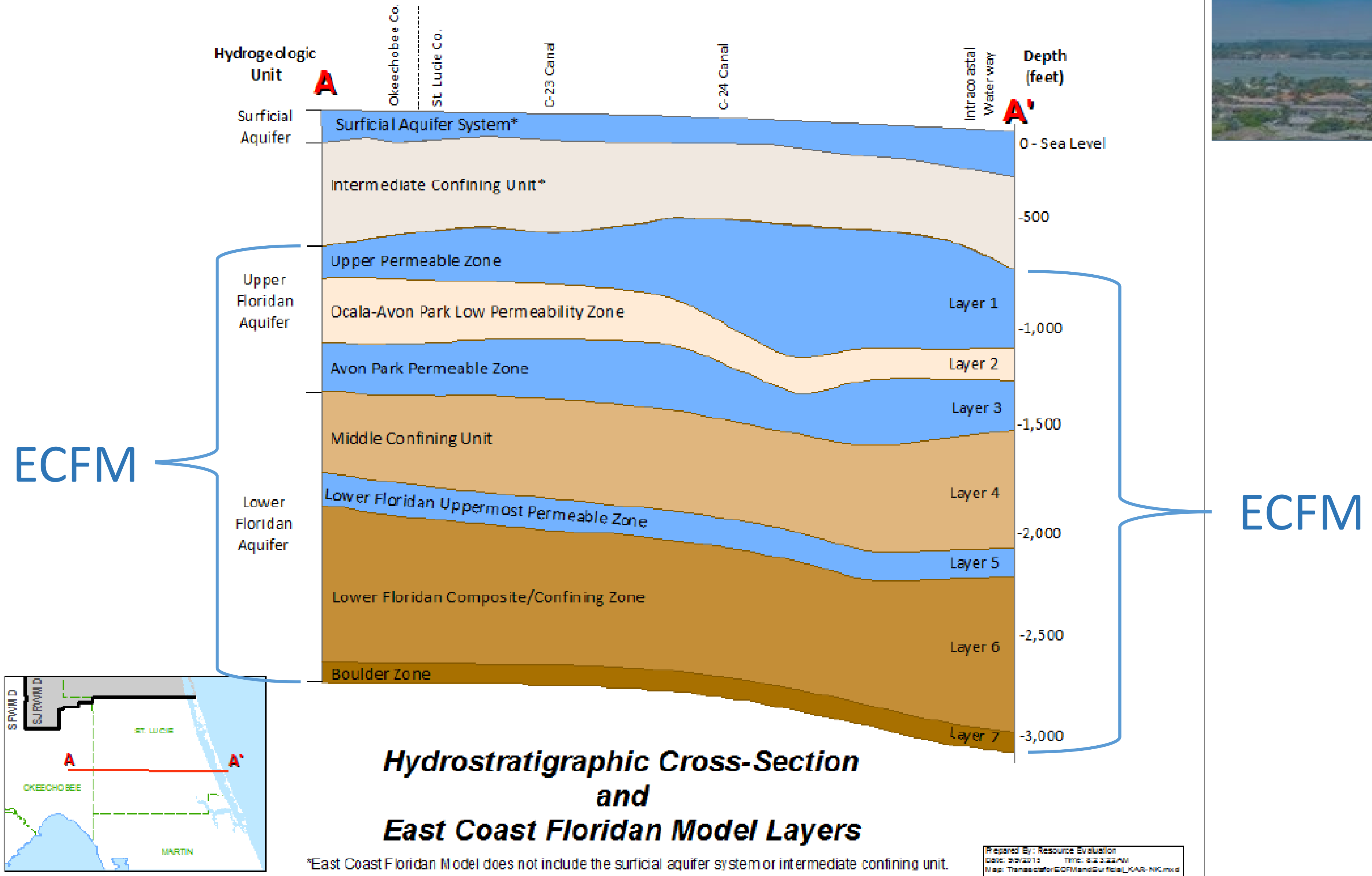
East Coast Floridan Model

- MODFLOW-SEAWAT Model (USGS 2012)
- Calibration period: 1989-2012
- 288 monthly simulation (stress) periods (288 ÷ 12 = 24 years)
- Cell size: 2,400 ft × 2,400 ft
- 7 model layers, including:
  - Layer 1: Upper Floridan aquifer
  - Layer 3: Avon Park permeable zone
- Calibrated to water levels and water quality (TDS concentration [mg/L])



ECFM Domain

UEC Planning Area



Hydrostratigraphic Cross-Section and East Coast Floridan Model Layers

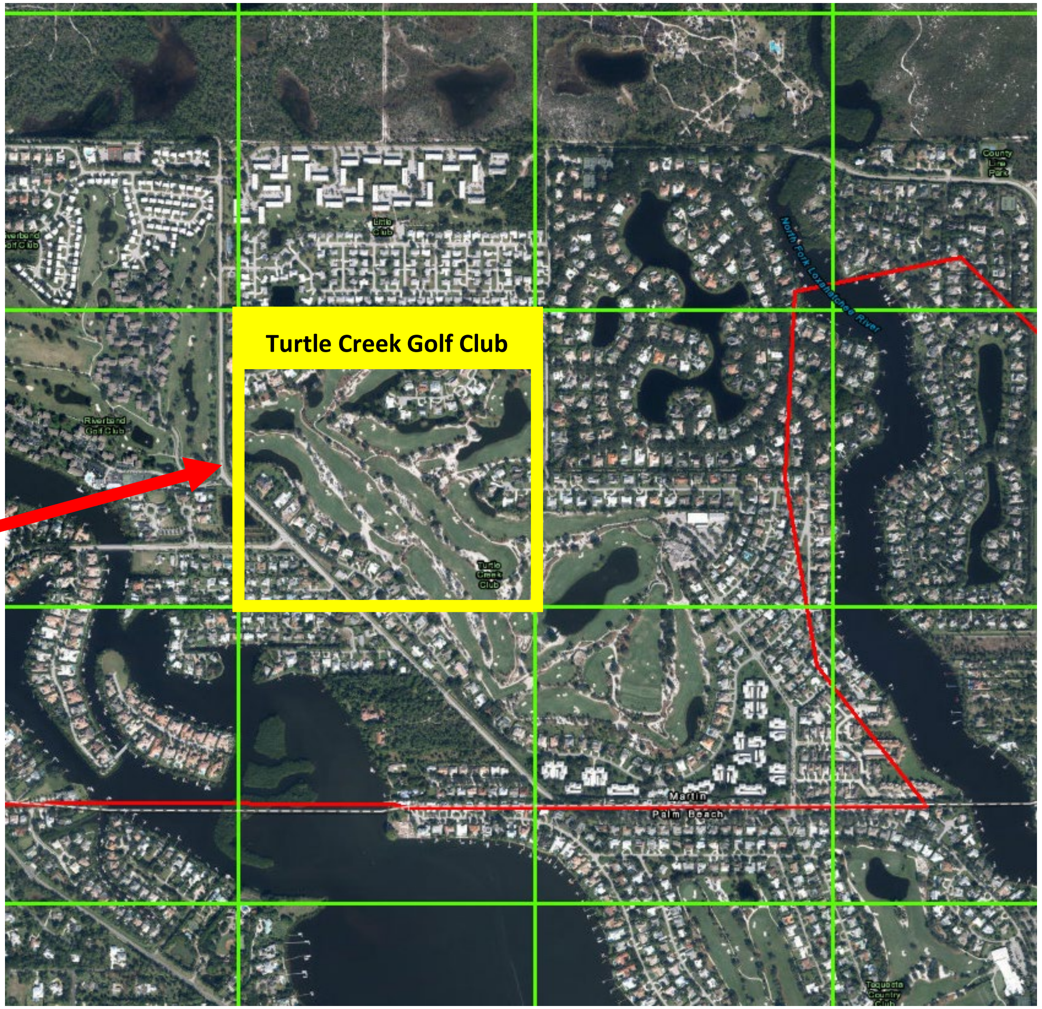
*East Coast Floridan Model does not include the surficial aquifer system or intermediate confining unit.

Considerations for Large Regional Models

- MODFLOW-SEAWAT: block-centered, finite-difference, cellular
- Heads and concentrations for each stress period are determined at each model cell
- Each ECFM model cell measures 2,400 ft × 2,400 ft in area

(132 acres)

- **Regional** trends and differences; local can be deceiving



Calibration Update and Comparison

(2014 ECFM vs. 2021 ECFM)

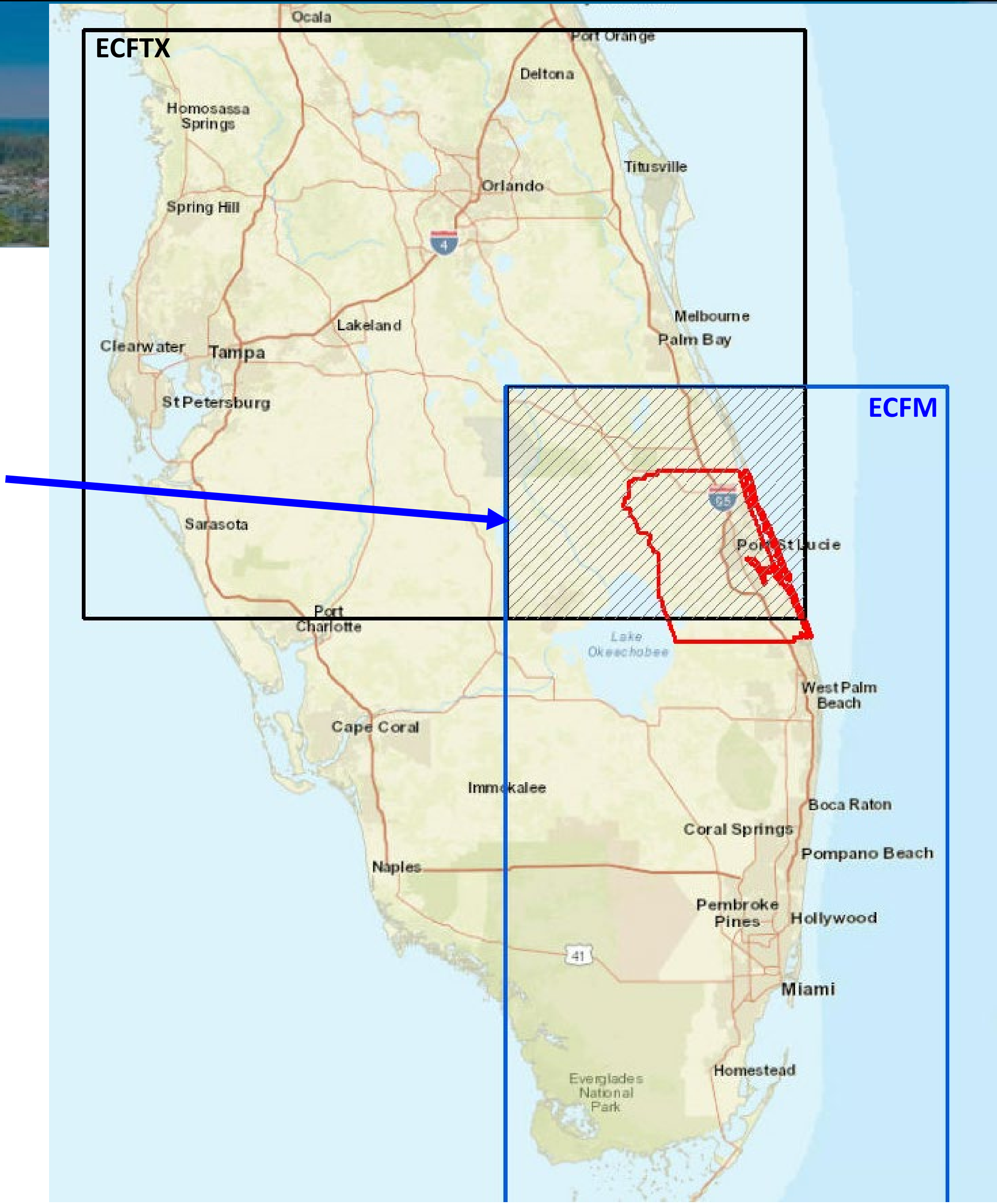
Update to the East Coast Floridan Model

- Modified the hydrostratigraphy (model layers) to be consistent with the East-Central Florida Transient Expanded (ECFTX) Model
- Incorporated new hydrogeologic information (hydraulic conductivity) into the model from six new sites
- Re-calibrated the model to meet calibration criteria

Updates to the East Coast Floridan Model

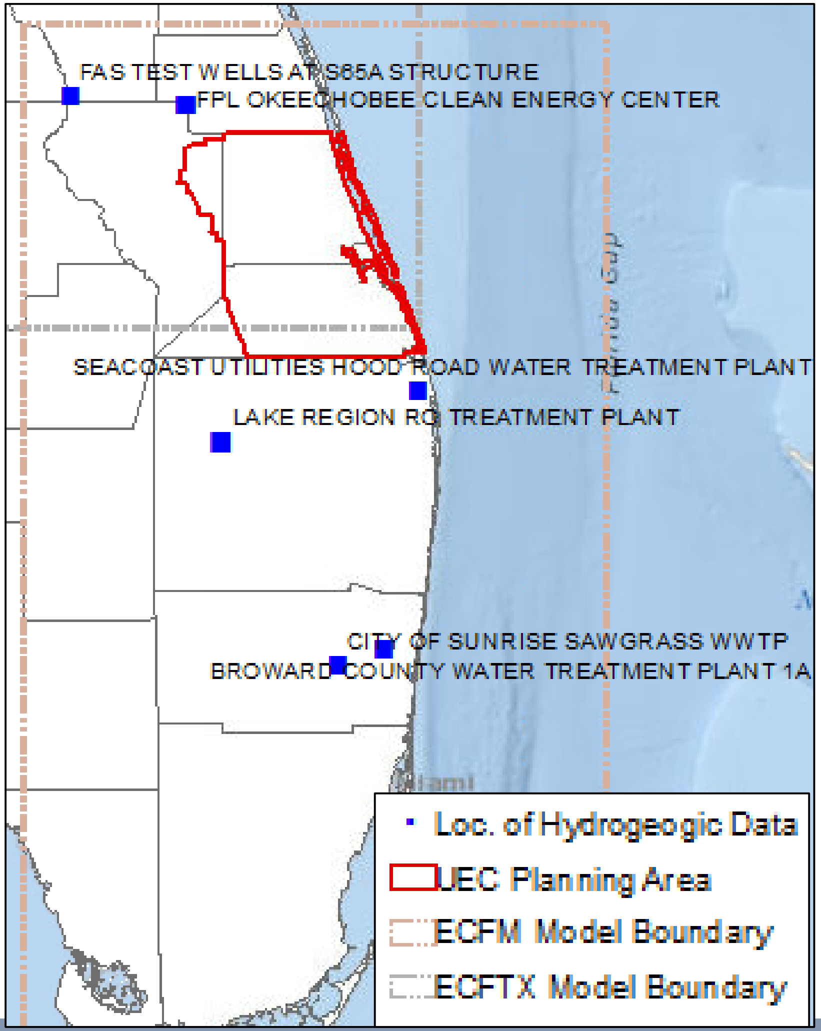
- Hydrostratigraphy (model layer elevation) data from the ECFTX Model was used in the area that overlaps the ECFM domain

- Within the overlapped area, ECFTX well data points were provided:
  - UFA top: 446 data points
  - UFA bottom: 38 data points
  - APPZ top: 37 data points
  - APPZ bottom: 22 data points



Updates to the East Coast Floridan Model

- Incorporated new hydrogeologic information
- New **hydraulic conductivity** was incorporated in **localized areas** in both the UFA and APPZ
    - Upper Floridan aquifer (UFA)
        - Okeechobee Clean Energy Center
        - Broward County Water Treatment Plant 1A
        - Lake Region Reverse Osmosis Treatment Plant
    - Avon Park permeable zone (APPZ)
        - S-65A structure at Kissimmee River Basin
        - Okeechobee Clean Energy Center
        - City of Sunrise Wastewater Treatment Facility
        - Seacoast Utility Authority


FAS TEST WELLS AT S65A STRUCTURE
FPL OKEECHOBEE CLEAN ENERGY CENTER
SEACOAST UTILITIES HOOD ROAD WATER TREATMENT PLANT
LAKE REGION RO TREATMENT PLANT
CITY OF SUNRISE SAWGRASS WWTP
BROWARD COUNTY WATER TREATMENT PLANT 1A
Florida Gap
Miami
Loc. of Hydrogeogic Data
UEC Planning Area
ECFM Model Boundary
ECFTX Model Boundary

Water Level Calibration Criteria

(from 2014 ECFM – recommended by the peer-review panel)

- Water level calibration criteria, by aquifer (UFA, APPZ, LFA):
  - Percent of simulated heads within ±2.0 ft of observed heads ≥80%
  - Percent of simulated heads within ±4.0 ft of observed heads ≥90%
  - Mean absolute error (MAE): <2.0 ft
    - 80% of wells in an aquifer with MAE <2.0 ft
  - Percentage of stations where ≥80% of the simulated heads are within ±2.0 ft of the observed heads ≥80%

Comparison of Water Level Calibration

(2021 vs. 2014)

Current Version 2021 ECFM

Aquifer	No. of Well Sites	No. of Records	% of Records Outside ±2.0 ft Interval	% of Records Outside ±4.0 ft Interval	% of Sites with <2 ft MAE (Goal: 80%)	% of Sites within ±2 ft Interval (Goal: 80%)
Upper Floridan aquifer	110	6,521	16%	2%	90%	75%
Avon Park permeable zone	27	1,835	10%	0%	96%	81%
Lower Floridan aquifer	6	502	15%	1%	83%	83%

SMMS Version* 2014 ECFM

Aquifer	No. of Well Sites	No. of Records	% of Records Outside ±2.0 ft Interval	% of Records Outside ±4.0 ft Interval	% of Sites with <2 ft MAE (Goal: 80%)	% of Sites within ±2 ft Interval (Goal: 80%)
Upper Floridan aquifer	110	6521	18%	2%	87%	61%
Avon Park permeable zone	27	1835	13%	1%	93%	59%
Lower Floridan aquifer	6	502	5%	1%	75%	75%

MAE = mean absolute error

* SMMS version is available at https://apps.sfwmd.gov/smmsviewer/

Water Quality Calibration Criteria

(from 2014 ECFM – recommended by the peer-review panel)

Calibration Target

For at least 80% of the monitoring wells, the model will simulate TDS within the error band:

	Fresh to Brackish Water		Moderately Saline	Saline Water
Observed total dissolved solids (mg/L)	0 – 4,000	4,000 – 10,000	10,000 – 18,000	>18,000
Calibration error band (mg/L)	±500	±750	±3,000	±4,000

Definition

A "calibrated well" is a well for which the model simulates TDS within the error band

Jacobs, B., M. Stewart, R. Therrien, and C. Zheng. 2011. Peer Review Report – East Coast Floridan Aquifer System Model Phase II Project, South Florida Water Management District, West Palm Beach, FL.

Comparison of Water Quality Calibration

(2021 vs. 2014)

- Percentage of data points (records) outside the desirable interval should be 20% or less
- Percentage of sites within the desirable interval should be 80% or greater

Current Version 2021 ECFM

Aquifer	Desirable Interval Criteria (± mg/L)	No. of Well Sites	No. of Records	% of Records Outside Desirable Interval	% of Sites Within Desirable Interval
UFA	500 – 750	102	5028	11%	90%
APPZ	500 – 4,000	63	4298	33%	71%
LFA	3,000 – 4,000	43	4165	23%	84%

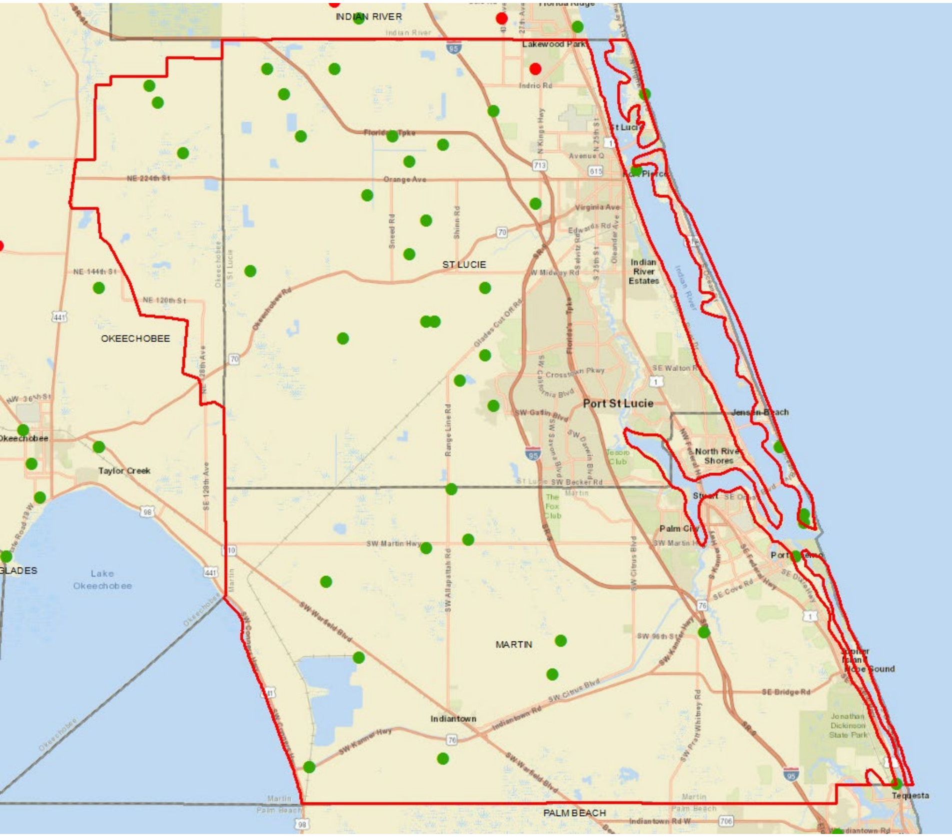
SMMS Version* 2014 ECFM

Aquifer	Desirable Interval Criteria (± mg/L)	No. of Well Sites	No. of Records	% of Records Outside Desirable Interval	% of Sites Within Desirable Interval
UFA	500 - 750	102	5028	10%	90%
APPZ	500 - 4000	63	4298	38%	65%
LFA	3000 - 4000	43	4165	25%	86%

* SMMS version is available at https://apps.sfwmd.gov/smmsviewer/

2021 East Coast Floridan Model Re-Calibration Summary

Water Level Calibration – Upper Floridan Aquifer

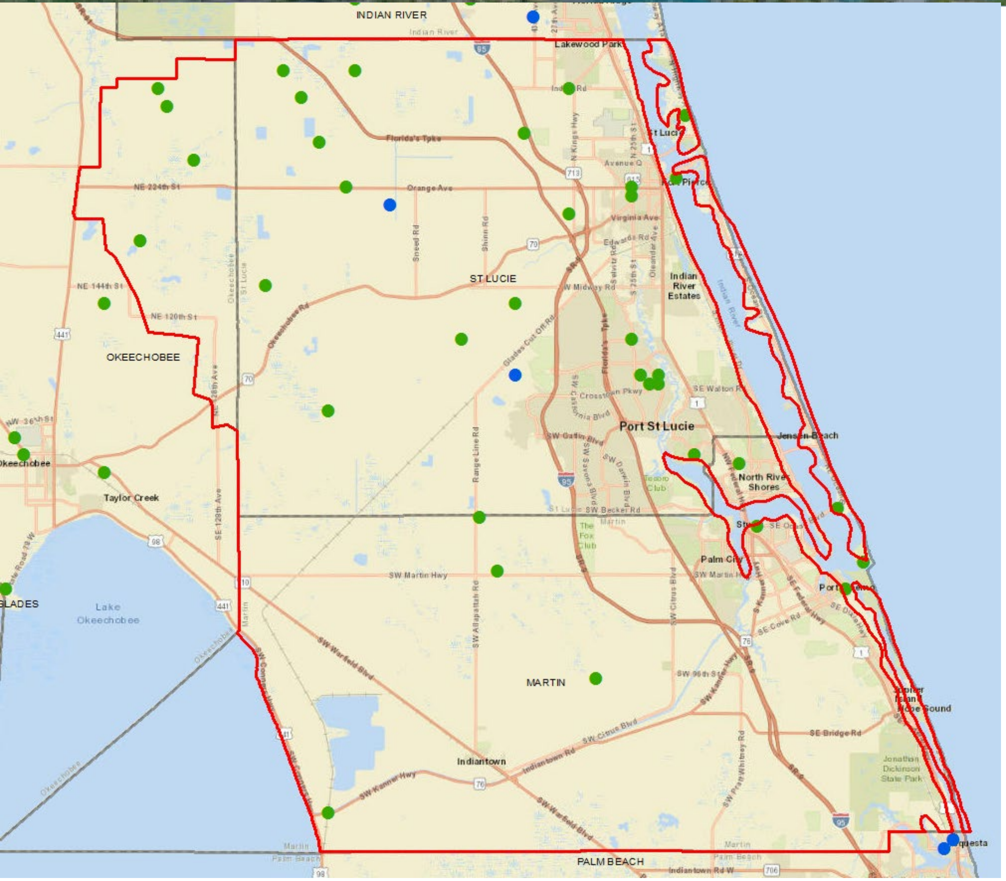


Note: Wells depicted in **green** meet calibration criteria
Wells depicted in **red** do not meet calibration criteria

39 out of 110 (35%) ECFM – UFA water level calibration targets inside the UEC Planning Area

	Criterion	All Layers	UFA in ECFM	UFA in UEC
Mean absolute error (MAE)	<2.0 ft	**1.21**	**1.25**	**1.13**
Number of wells		143	110	39
% of wells with MAE <2.0 ft	>80%	**92%**	**90%**	**97%**

Water Quality Calibration – Upper Floridan Aquifer

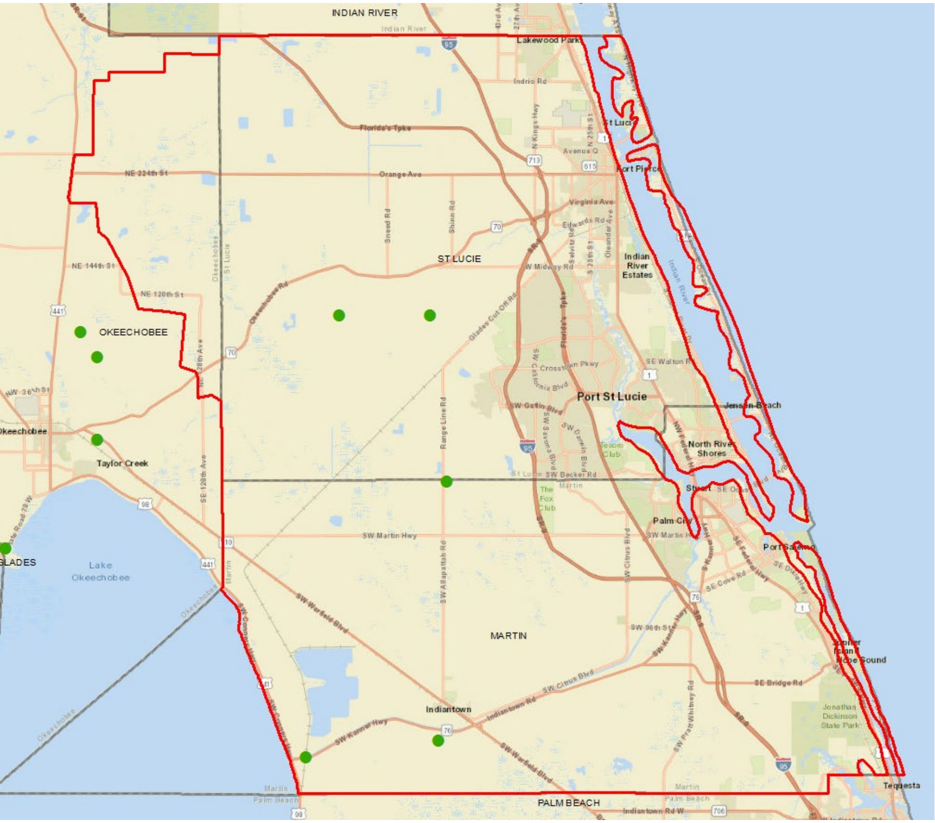


Note: Wells depicted in **green** meet calibration criteria
Wells depicted in **blue** do not meet calibration criteria

37 out of 102 (36%) ECFM – UFA water quality calibration targets inside the UEC Planning Area

	Criterion	All Layers	UFA in ECFM	UFA in UEC
Number of wells		208	102	37
Number of wells meeting calibration		175	92	35
Percentage of calibrated wells	80%	84%	90%	95%

Water Level Calibration – Avon Park Permeable Zone

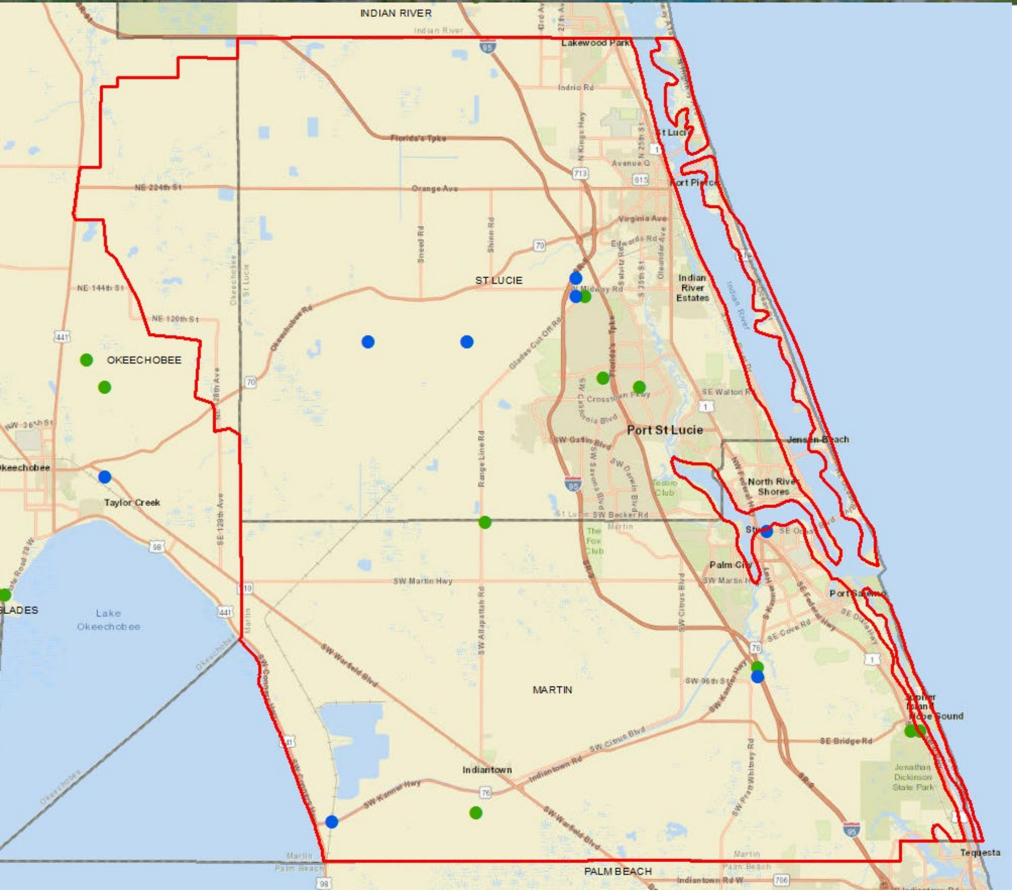


Note: Wells depicted in **green** meet calibration criteria

5 out of 27 (19%) ECFM – APPZ water level calibration targets inside the UEC Planning Area

	Criterion	All Layers	APPZ in ECFM	APPZ in UEC
Mean absolute error (MAE)	<2.0 ft	**1.21**	**1.04**	**0.92**
Number of wells		143	27	5
% of wells with MAE <2.0 ft	>80%	**92%**	**96%**	**100%**

Water Quality Calibration – Avon Park Permeable Zone

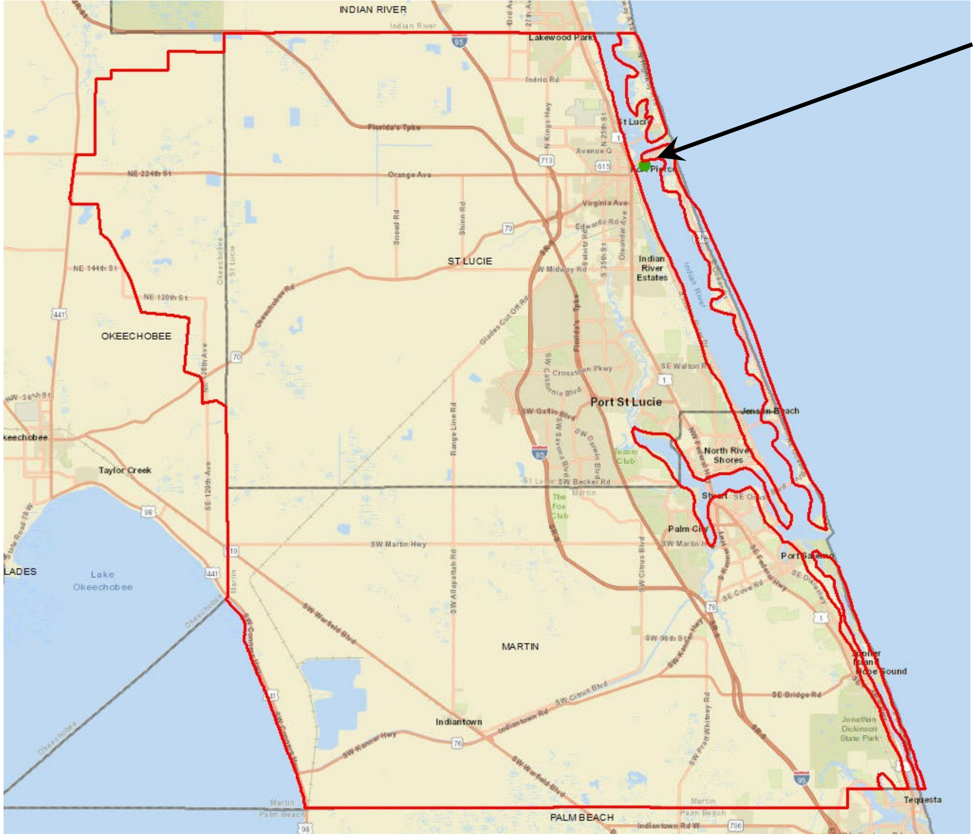


Note: Wells depicted in **green** meet calibration criteria
Wells depicted in **blue** do not meet calibration criteria

15 out of 63 (24%) ECFM – APPZ water quality calibration targets inside the UEC Planning Area

	Criterion	All Layers	APPZ in ECFM	APPZ in UEC
Number of wells		208	63	15
Number of wells meeting calibration		175	46	8
Percentage of calibrated wells	80%	84%	71%	53%

Water Level Calibration – Lower Floridan Aquifer

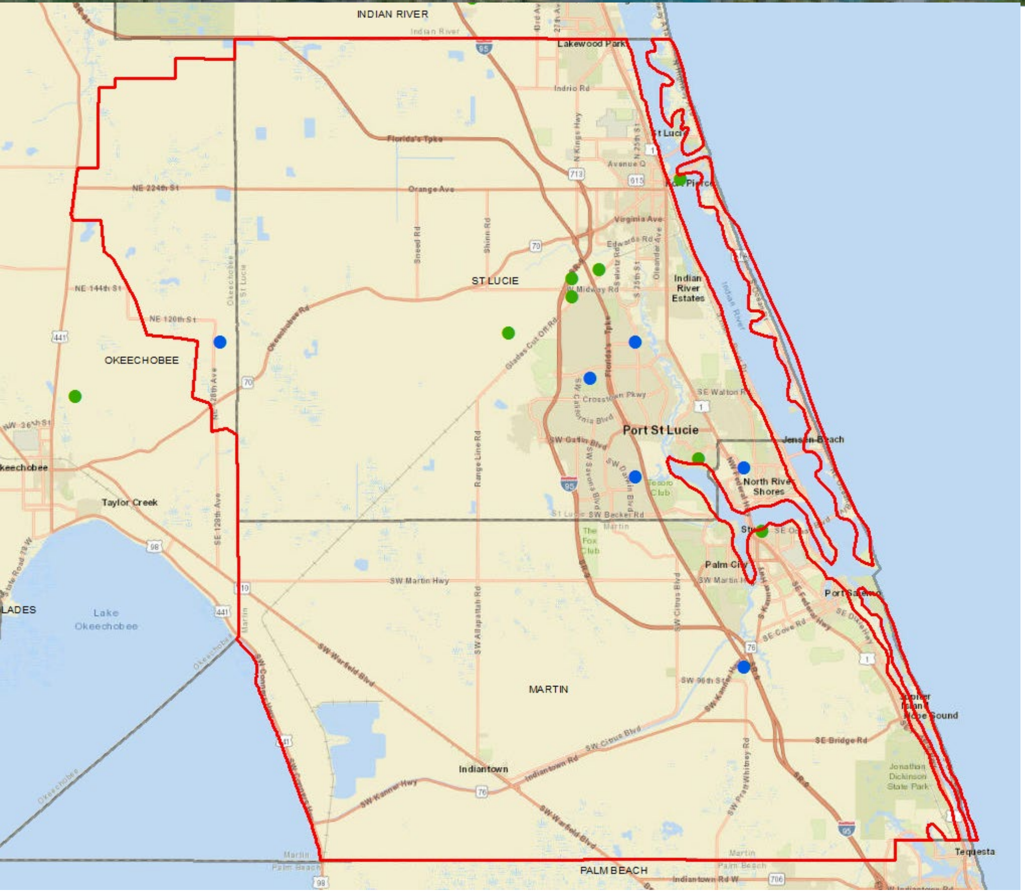


There is only one ECFM – LFA water level calibration target inside the UEC Planning Area

Note: Well depicted in green meets calibration criteria

	Criterion	All Layers	LFA in ECFM	LFA in UEC
Mean absolute error (MAE)	<2.0 ft	1.21	1.16	0.85
Number of wells		143	6	1
% of wells with MAE <2.0 ft	>80%	92%	83%	100%

Water Quality Calibration – Lower Floridan Aquifer



12 out of 43 (27%) ECFM – LFA water quality calibration targets inside the UEC Planning Area

	Criterion	All Layers	LFA in ECFM	LFA in UEC
Number of wells		208	43	13
Number of wells meeting calibration		175	36	7
Percentage of calibrated wells	80%	84%	84%	54%

Note: Wells depicted in **green** meet calibration criteria
Wells depicted in **blue** do not meet calibration criteria

Model Application: Upper East Coast Planning Scenarios

Upper East Coast Planning Scenarios

- **2019 Base Condition**
  - Public Supply, Power Generation, Landscape/Recreational, and Commercial/Industrial/Institutional demands from historical 2019 pumpage data
  - Agricultural demands estimated based on AFSIRS (simulates irrigation demands)
- **2045 Future Condition**
  - Public Supply, Power Generation, and Commercial/Industrial/Institutional demands based on future population growth rate
  - Agricultural demands based on future land use (FSAID 2019*) and AFSIRS
  - Landscape/Recreational demands based on 2045 planning projections
- Differences in water levels and water quality (TDS) between 2019 and 2045 in the UFA and APPZ (model layers 1 and 3)

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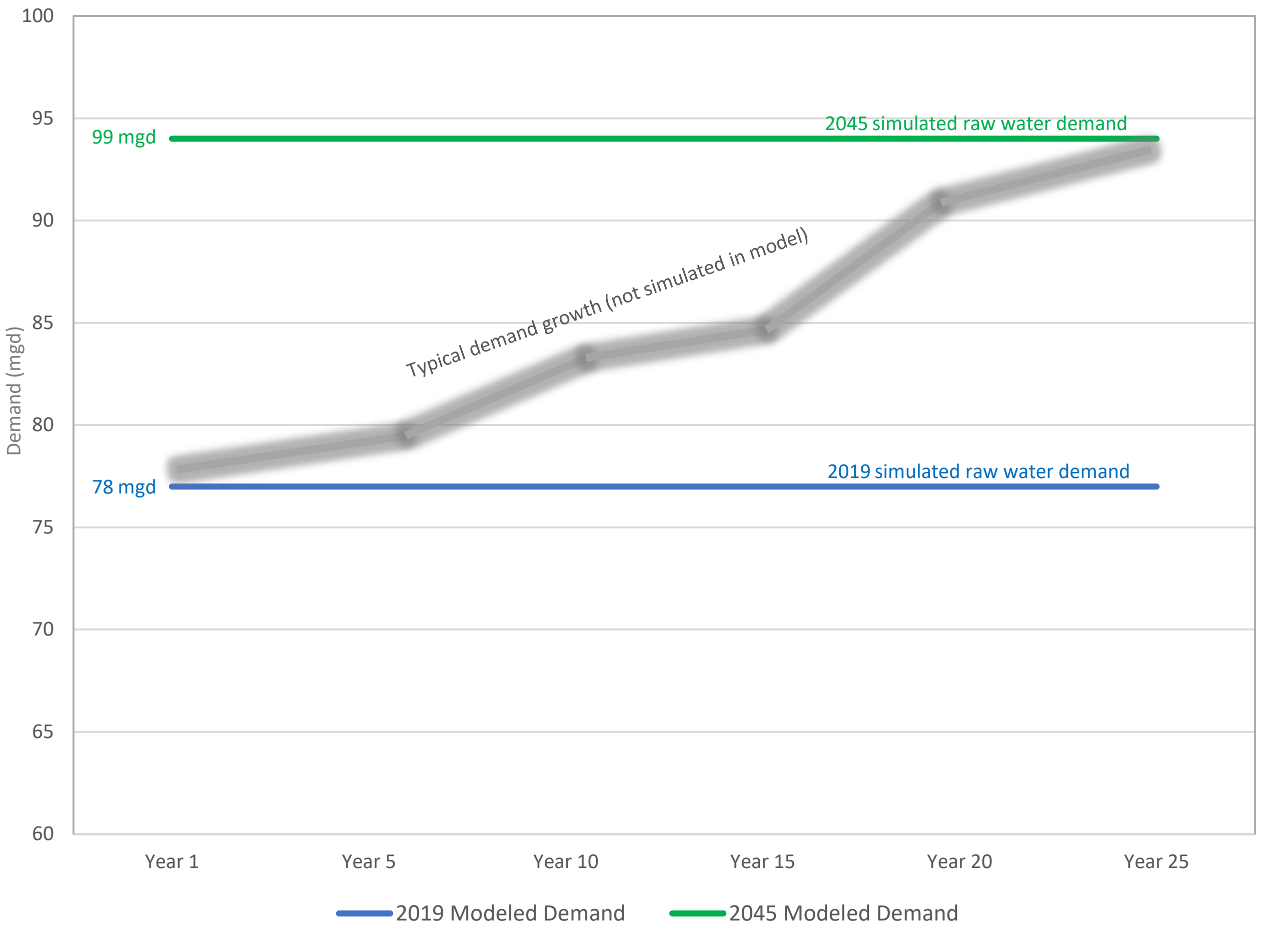
* Florida Statewide Agricultural Irrigation Demand Report 2019

Limitations in Simulating Demands

- Each simulation is 24 years
  - Same as calibration period
- Model does not simulate annual demand growth
- Simulated demands are "instant on"
- Raw water demand shown for all use types
- Results from the 2045 simulation are considered conservative



Regional Model Limitations

- Large model cell size (2,400 ft × 2,400 ft)
  - Cannot accurately simulate local drawdowns
- Regional model may not capture local heterogeneity in the FAS and the response at individual wells
- Regional model results should be used as an overall planning tool; results should not be considered absolute

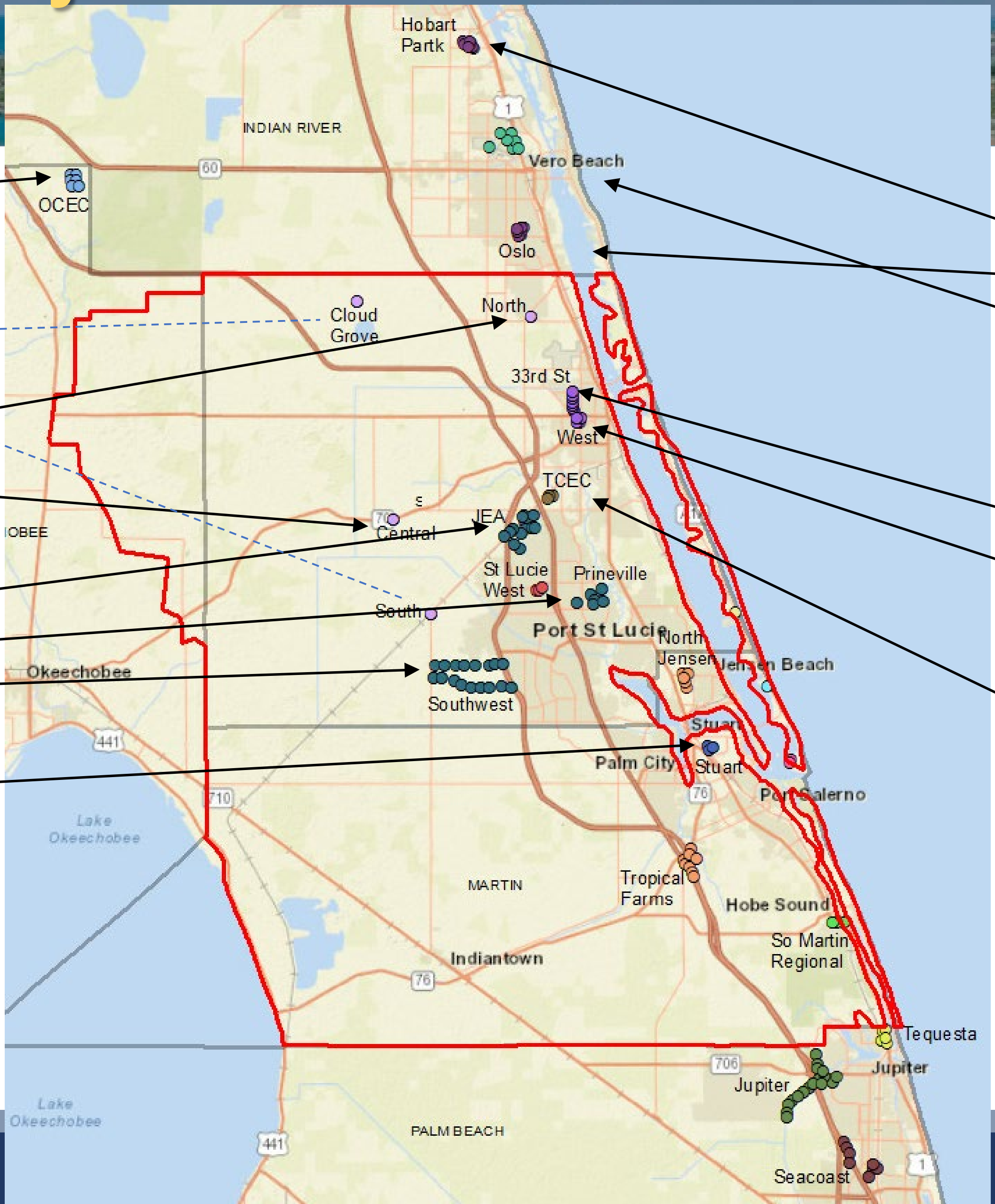
Floridan Aquifer Demands in the Upper East Coast Planning Area

Water Use Category	2019 (mgd)	2045 (mgd)	Difference (mgd)
Agriculture	37.87	31.45	-6.42
Commercial/Industrial/Institutional	0.18	0.18	0.00
Landscape/Recreational	2.74	4.20	1.46
Power Generation	1.45	3.34	1.89
Public Supply	36.18	59.74	23.56
Total	**78.42**	**98.91**	**20.49**

Differences in PS Demands in the UEC Planning Area

Permit Number	Utility	Allocation (mgd)	2019 (mgd)	2045 (mgd)	Difference (mgd)
Martin County					
43-00053-W	Stuart, City of	3.67	0.00	2.62	2.62
43-00066-W	South Martin Regional Utility	2.50	1.78	2.43	0.65
43-00102-W	Martin County Utilities (Consolidated System)	15.09	9.98	10.63	0.65
43-00146-W	Sailfish Point Utility Corporation	0.22	0.21	0.22	0.01
St. Lucie County					
56-00085-W	Fort Pierce Utilities Authority	13.13	3.42	5.85	2.43
56-00142-W	Port St. Lucie Utility Systems Department, City of	30	18.33	30.08	11.75
56-00406-W	St. Lucie County Utilities	6.65	0.00	5.40	5.40
56-00614-W	St. Lucie West Services District	3.10	2.20	2.23	0.03

2045 Projected Demands at FAS Wellfields



Okeechobee Clean Energy Center (PG)

- 1.37 mgd increase UFA
- 2.07 mgd increase APPZ

St. Lucie County Utilities

- *5.4 mgd increase*
  - *No pumping in 2019*
  - *4 mgd from North in 2045*
  - *1.4 mgd from Central in 2045*
  - *UFA only*

Port St. Lucie Utility Systems Dept.

- *JEA: 0.94 mgd decrease*
- *Prineville: 0.27 mgd decrease*
- *Southwest: 12.96 mgd increase*
  - *3.53 mgd from UFA, 9.43 mgd from APPZ*

City of Stuart

- *2.62 mgd increase*
  - *No pumping in 2019*
  - *Mostly APPZ in 2045*

(2.6 mgd APPZ, 0.02 mgd UFA)

Hobart & Oslo

- *1.93 mgd increase Hobart*
- *0.7 mgd decrease Oslo*
- *UFA only*

City of Vero Beach

- *1.67 mgd increase, UFA only*

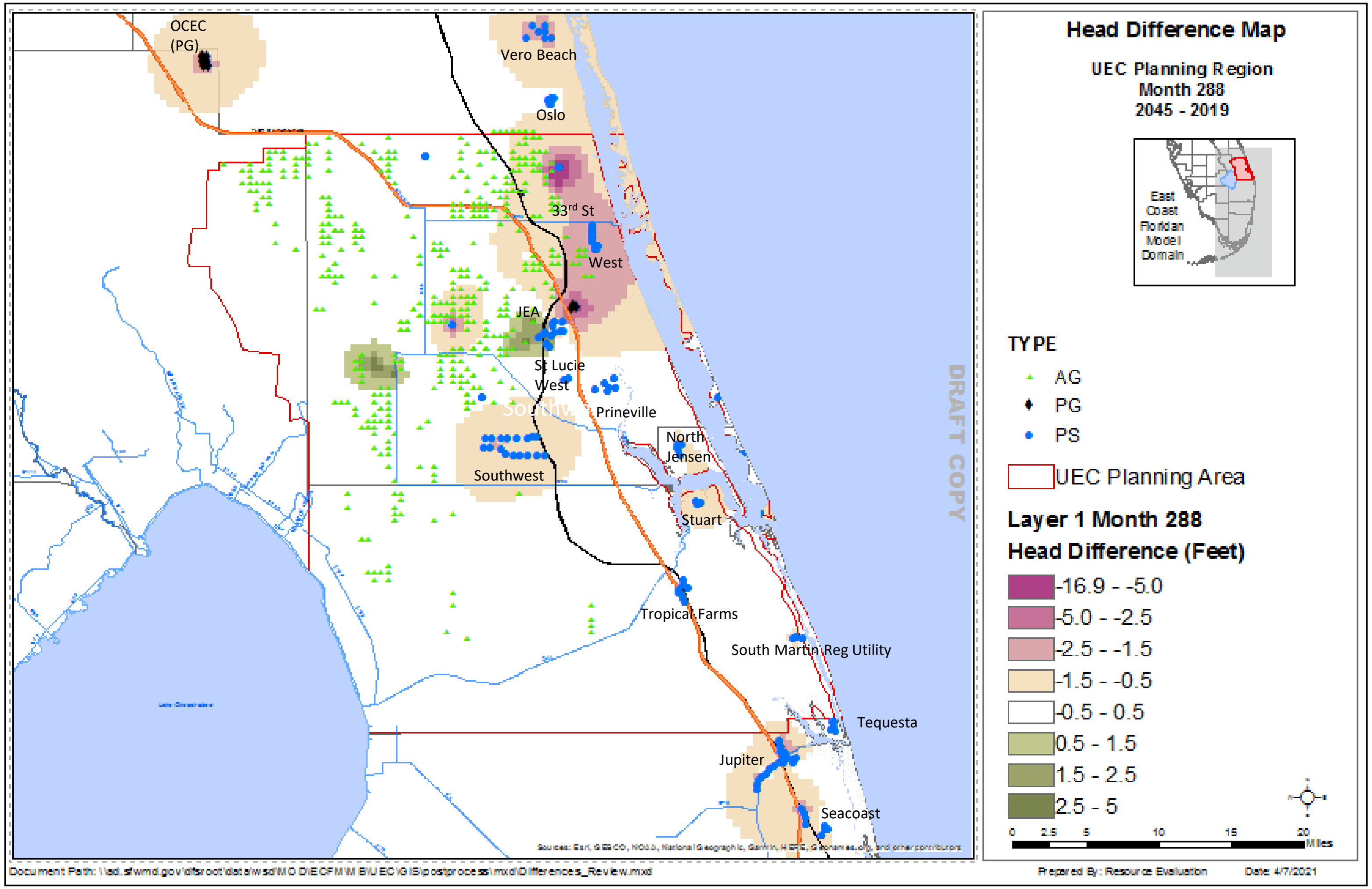
Fort Pierce Utilities Authority

- *2.43 mgd increase*
  - *33rd St. UFA increase = 1.17 mgd*
  - *33rd St. APPZ increase = 0.28 mgd*
  - *West UFA increase = 0.94 mgd*
  - *West APPZ increase = 0.05 mgd*

Treasure Coast Energy Center (PG)

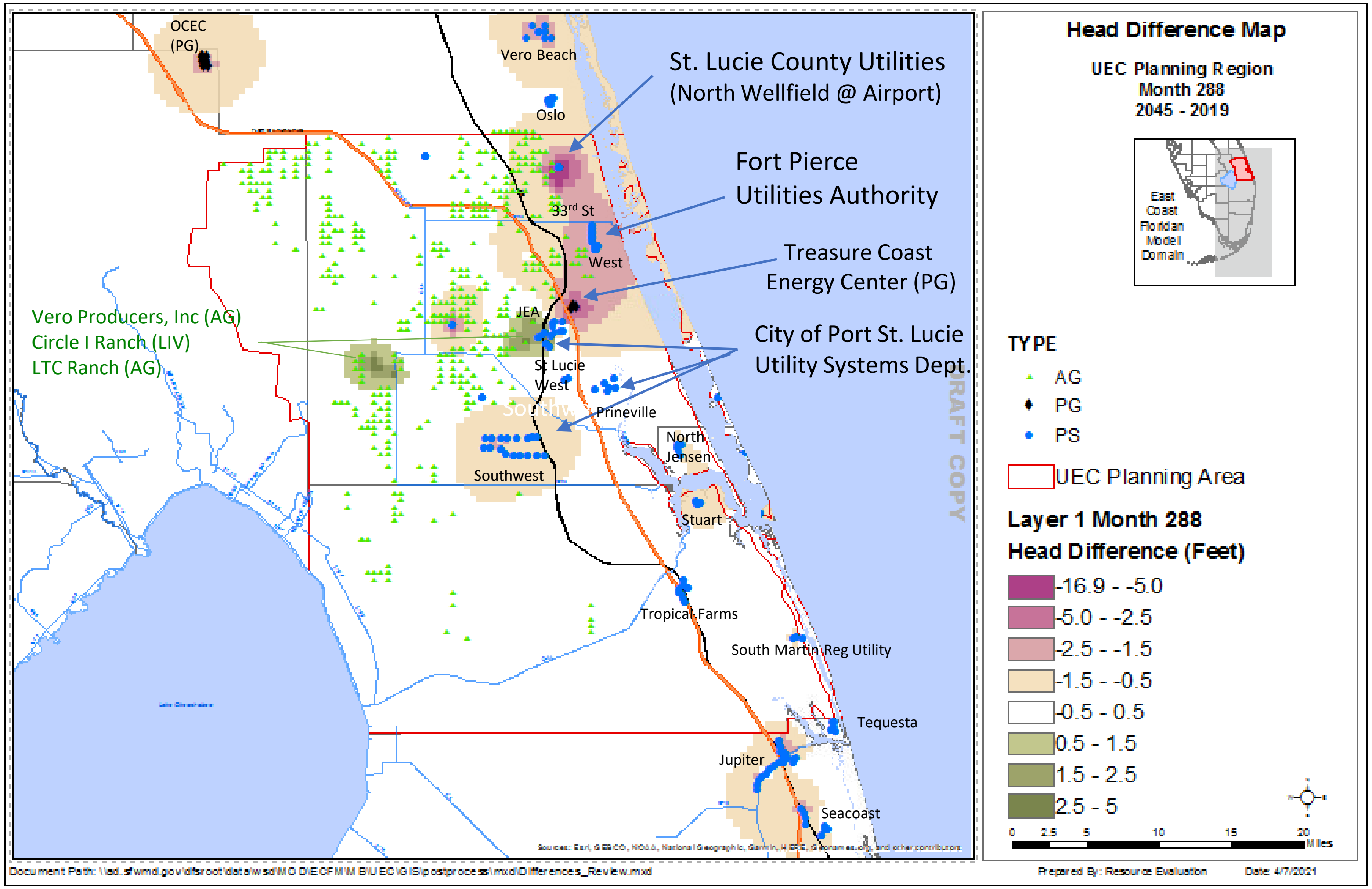
- *1.89 mgd increase, UFA only*

How to Read the Results



- Legend
  - Month 288: Last month in planning scenario model runs
  - Type:
    - ▲ AG = Agriculture
    - ◆ PG = Power Generation
    - ● PS = Public Supply
  - Well symbols
  - Layer (1 or 3)
  - Planning area boundary
  - Head difference in feet
    - 2045 head minus 2019 head

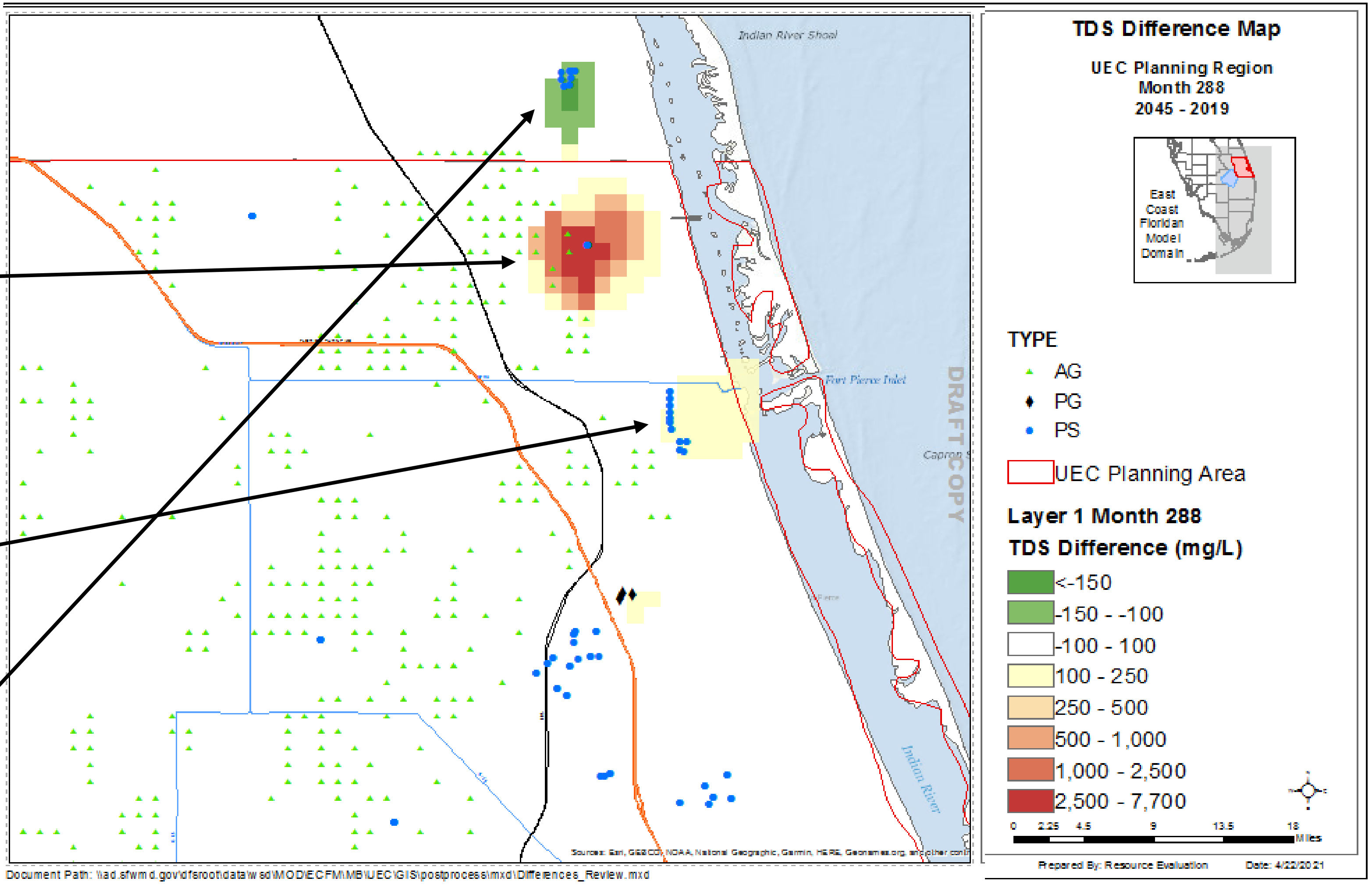
Upper Floridan Aquifer Water Level Difference
(2045 - 2019)



- ~17 ft of drawdown at St. Lucie County Utilities (North Wellfield)
  - No FAS demand in 2019
  - 4 mgd in 2045
- ~6.5 ft of additional drawdown at Treasure Coast Energy Center Power Generation wells
  - 1.9 mgd increase
- Up to 3 ft of rebound at City of Port St. Lucie (JEA Wellfield)
  - 0.42 mgd decrease
  - Agricultural demand decreases may contribute

Upper Floridan Aquifer Water Quality Difference (2045 – 2019)

- TDS differences of <100 mg/L in most of the area
- Increase in TDS at St. Lucie County Utilities (North Wellfield):
  - Increase in demands 0 to 4 mgd
  - TDS increase as high as 4,800 mg/L
- Slight increase in TDS at Fort Pierce Utilities Authority
  - 33rd St. demand increase from 1.64 to 2.81 mgd
  - West demand increase from 1.32 to 2.26 mgd
- Slight decrease in TDS at Oslo Water Treatment Plant
  - Demand decreases from 6.28 to 5.58 mgd



Sources: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contr

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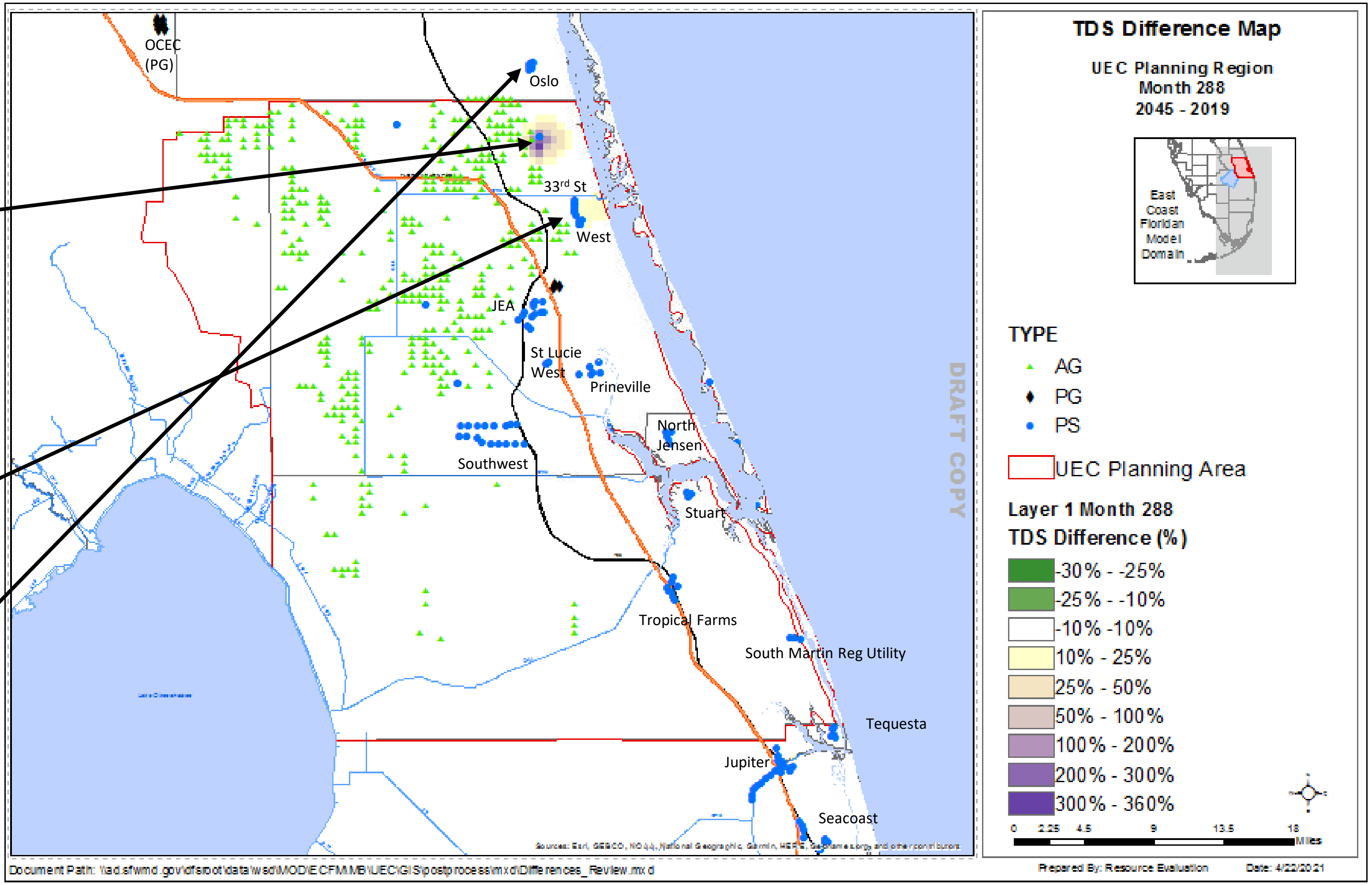
Prepared By: Resource Evaluation Date: 4/22/2021

Upper Floridan Aquifer Water Quality % Difference (2045 – 2019)

- TDS % differences of <10% in most of the area
- Increase in TDS at St. Lucie County Utilities (North Wellfield) ~360%:
  - Increase in demands = 4 mgd
- Slight increase in TDS at Fort Pierce Utilities Authority ~14%
  - 33rd St. demand increase from 1.64 to 2.81 mgd
  - West demand increase from 1.32 to 2.26 mgd
- Slight decrease in TDS at Oslo Water Treatment Plant ~3%
  - Demand decreases from 6.28 to 5.58 mgd



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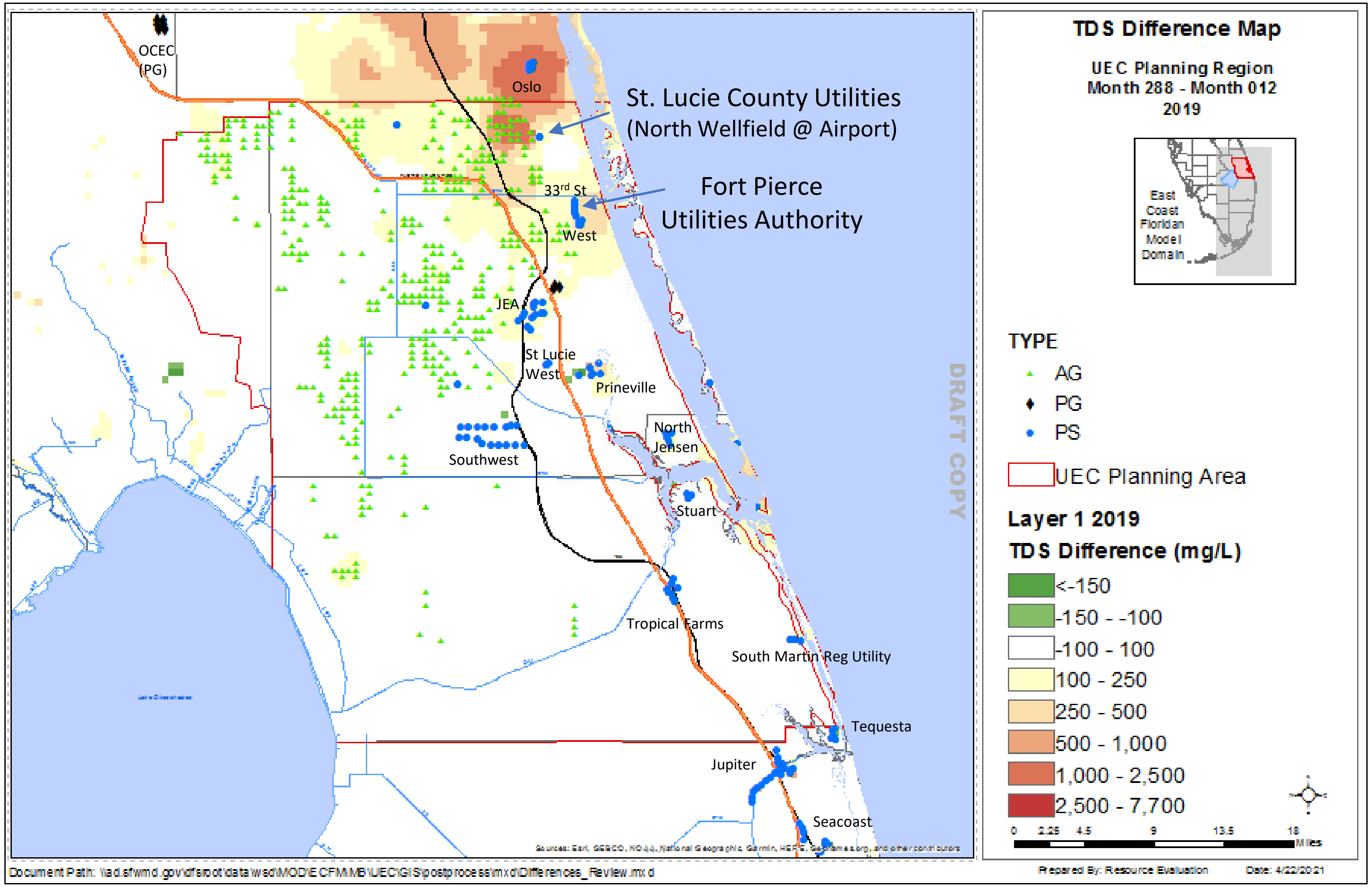
Prepared By: Resource Evaluation

Date: 4/22/2021

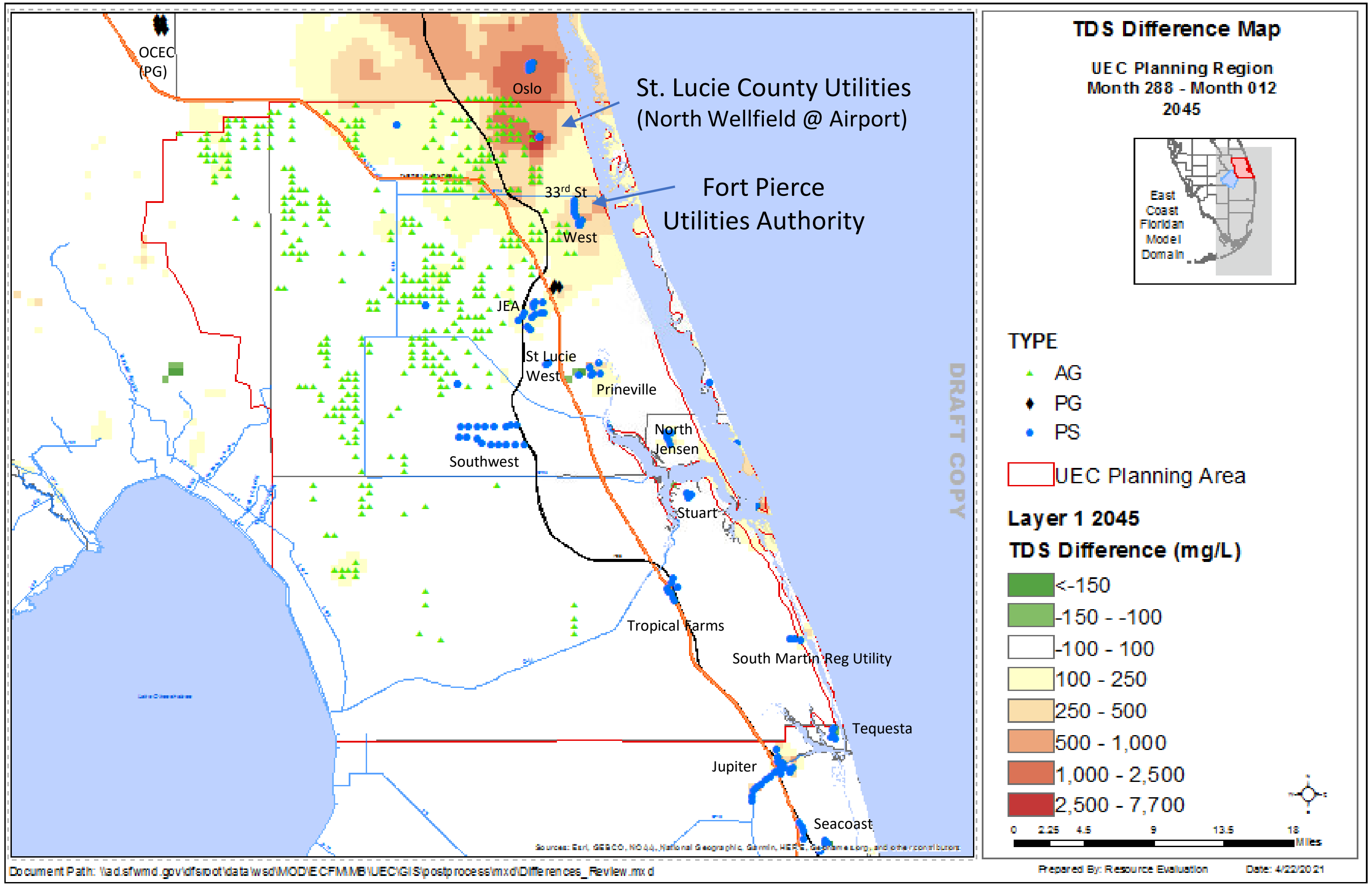
Upper Floridan Aquifer Water Quality Difference

- Difference in TDS concentrations within the ECFM **2019** scenario model run (Year 1 to 24)
- Highest TDS increase within UEC Planning Area is near St. Lucie County Utilities (North Wellfield at Airport)
  - 2,100 mg/L
  - *No pumping in 2019 at North Wellfield*
  - *Increase likely due to Oslo WTP and AG demands in 2019*



Upper Floridan Aquifer Water Quality Difference

- Difference in TDS concentrations within the ECFM **2045** scenario model run (Year 1 to 24)
- Highest TDS increase within UEC Planning Area is at St. Lucie County (North Wellfield at Airport)
    - 4,600 mg/L
    - *North Wellfield demand = 4 mgd in 2045*


St. Lucie County Utilities (North Wellfield @ Airport)

Fort Pierce Utilities Authority

Sources: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributors

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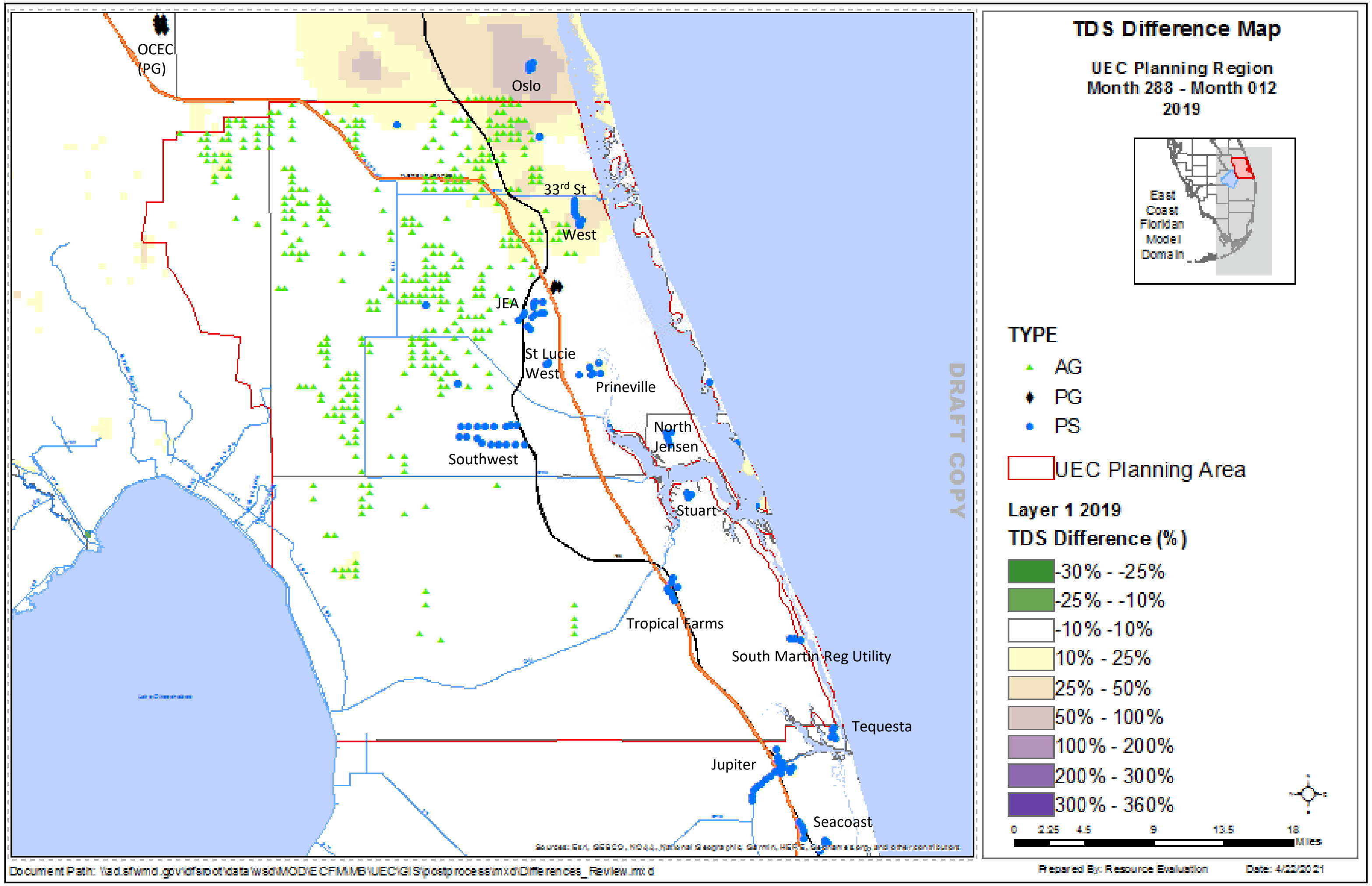
Prepared By: Resource Evaluation

Date: 4/22/2021

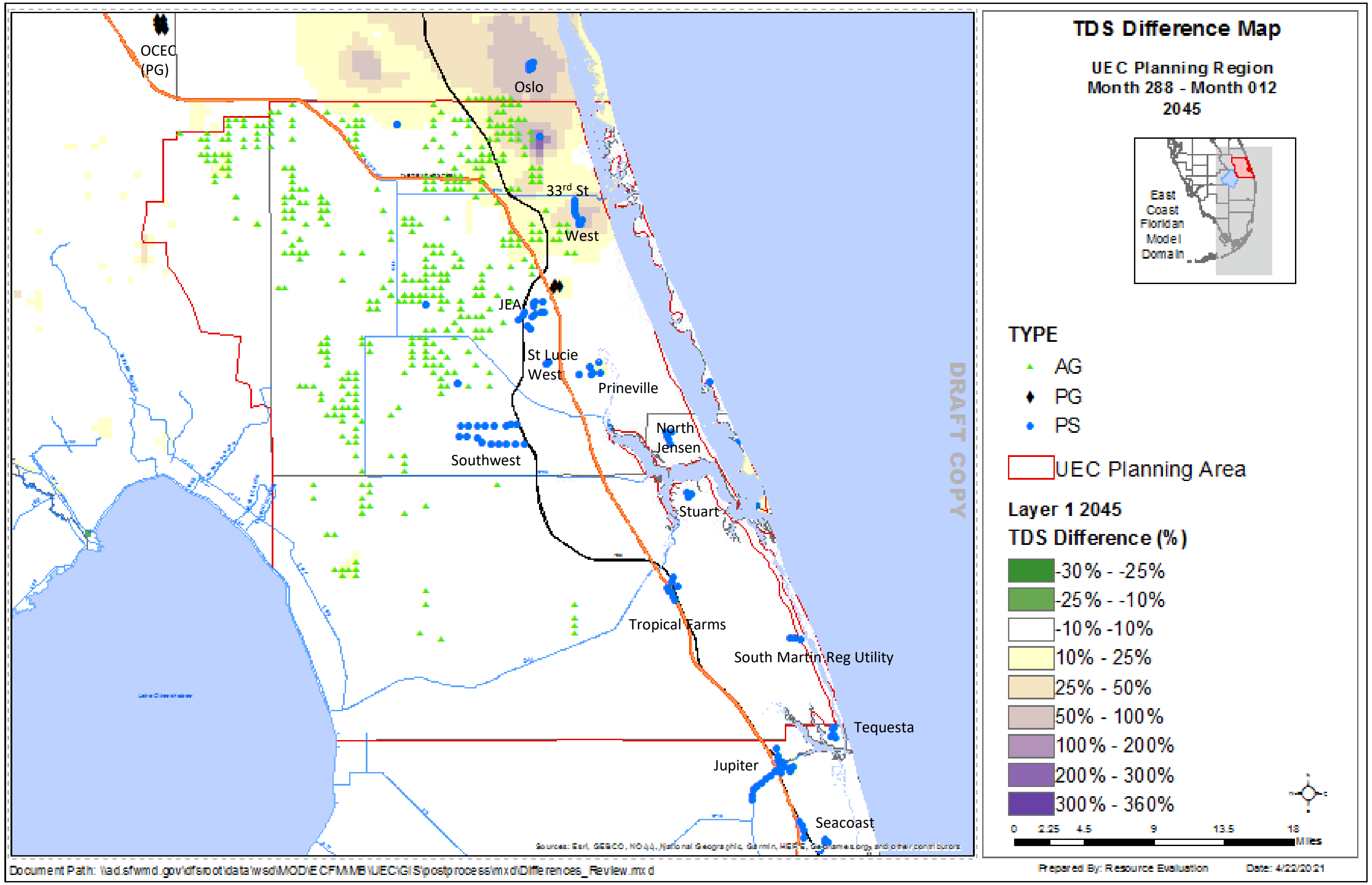
Upper Floridan Aquifer Water Quality Difference

- % difference in TDS concentrations within the ECFM **2019** scenario model run (Year 1 to 24)
- Highest TDS % increase within UEC Planning Area is near St. Lucie County Utilities (North Wellfield at Airport): **53%**
  - *No pumping in 2019 at North Wellfield*
  - *Increase likely due to Oslo WTP and AG demands in 2019*

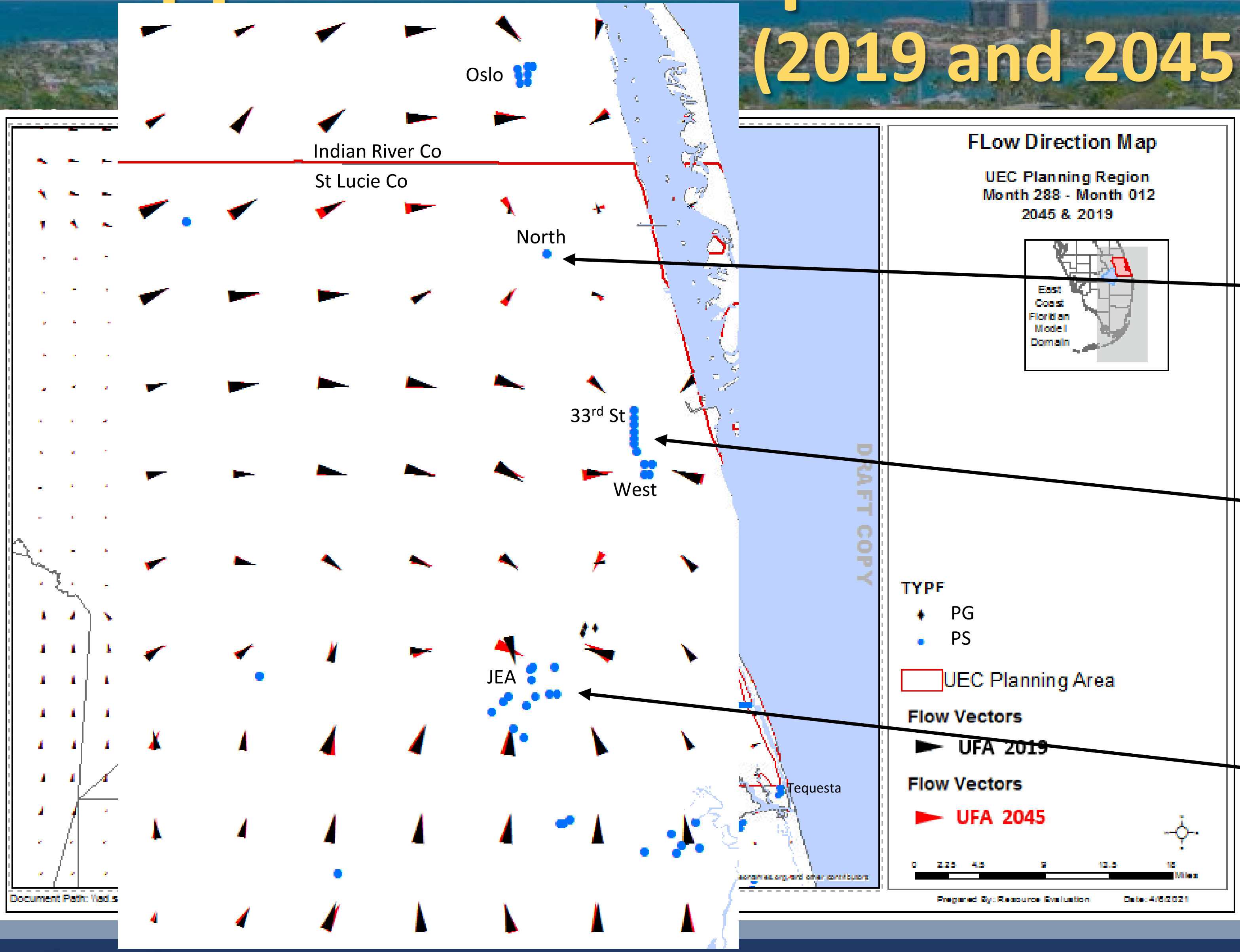


Upper Floridan Aquifer Water Quality Difference

- % difference in TDS concentrations within the ECFM **2045** scenario model run (Year 1 to 24)
- Highest TDS % increase within UEC Planning Area is at St. Lucie County Utilities (North Wellfield at Airport): **291%**
  - *North Wellfield demand = 4 mgd in 2045*



Upper Floridan Aquifer Horizontal Flow Vectors (2019 and 2045)

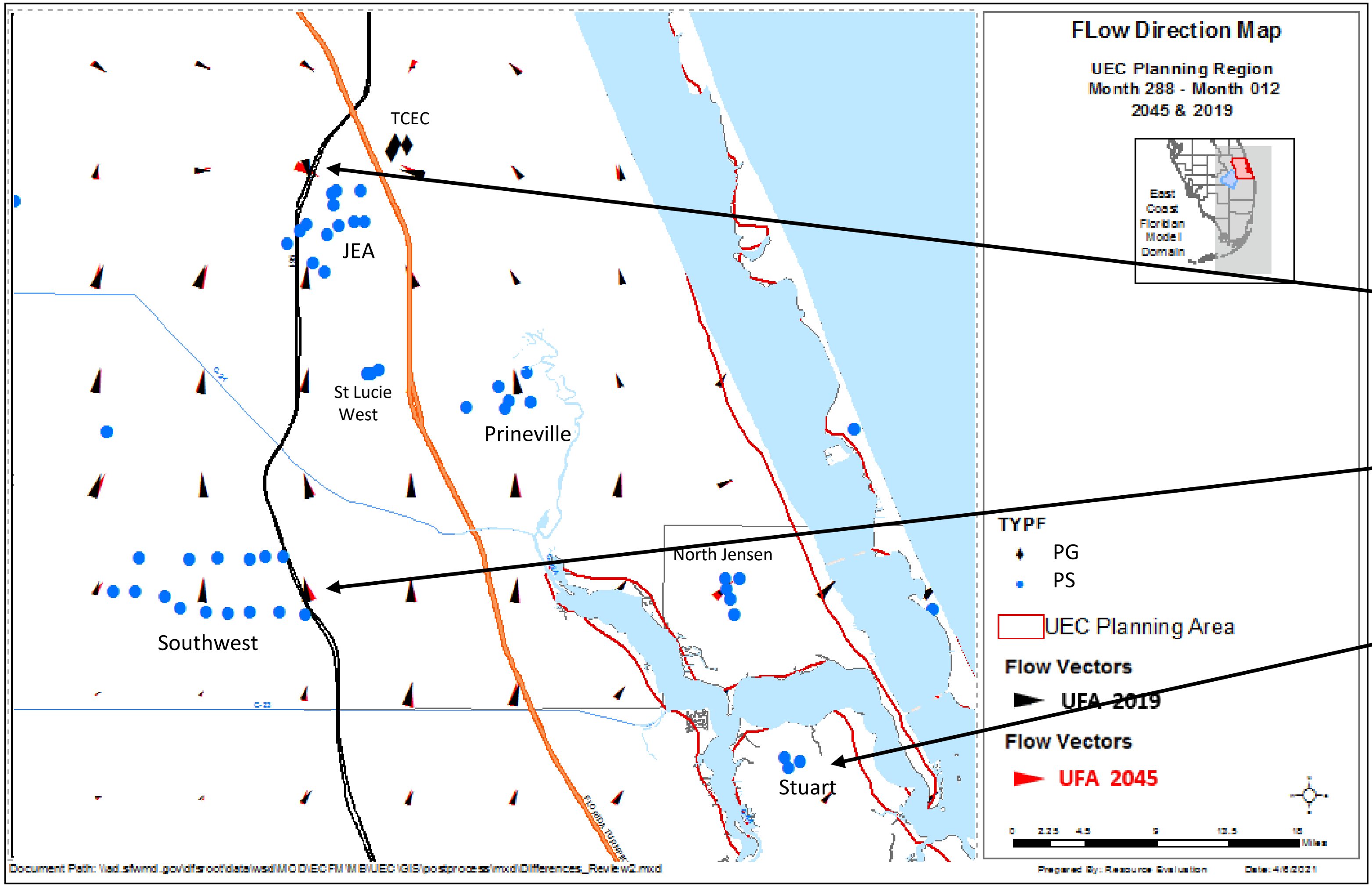


- Differences in flow direction and magnitude can be seen at:
  - St. Lucie County Utilities (North Wellfield)
    - Increase in horizontal flow from the western area
    - Demand increases from 0 to 4 mgd
  - Fort Pierce Utilities Authority
    - Increase in horizontal flow from the western area
    - Lateral saltwater intrusion
    - 33rd St. demand increases from 1.64 to 2.81 mgd
    - West demand increases from 1.32 to 2.26 mgd
  - City of Port St. Lucie Utility Systems Department (JEA Wellfield)
    - Change in horizontal flow from the surrounding area
    - Slight demand decrease of 0.4 mgd

Vectors represent horizontal flow averaged over 25 model cells

Upper Floridan Aquifer Horizontal Flow Vectors (2019 and 2045)

Oslo



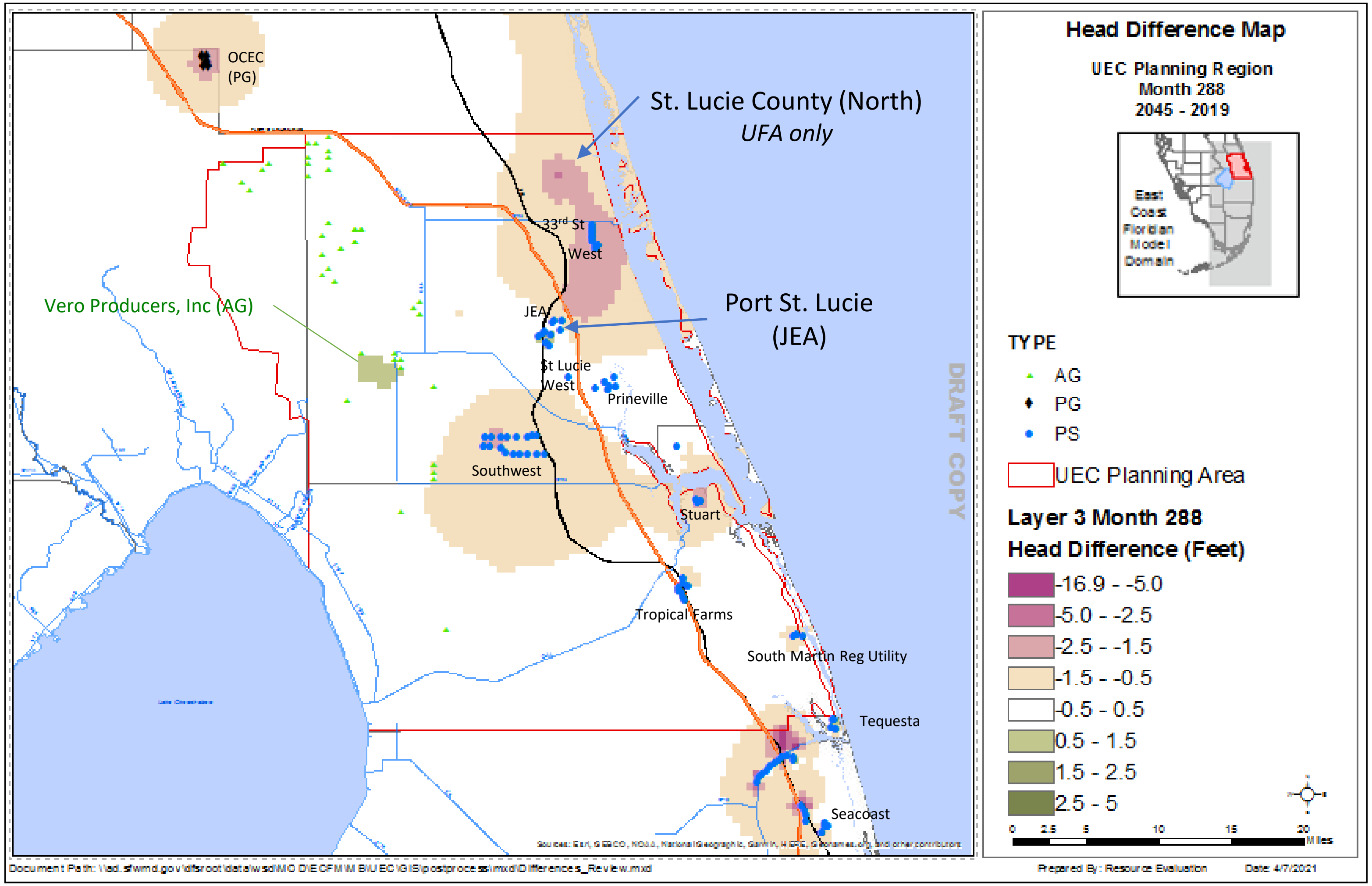
➢ Differences in flow direction and magnitude can be seen at:

- City of Port St. Lucie Utility Systems Department (JEA Wellfield)
  - Change in horizontal flow from the surrounding area
  - Slight demand decrease of 0.4 mgd
- City of Port St. Lucie Utility Systems Department (Southwest Wellfield)
  - Slight change in horizontal flow
  - UFA demand increase of 3.53 mgd
- City of Stuart
  - No noticeable change in UFA flow

Vectors represent horizontal flow averaged over 25 model cells

Avon Park Permeable Zone Water Level Difference

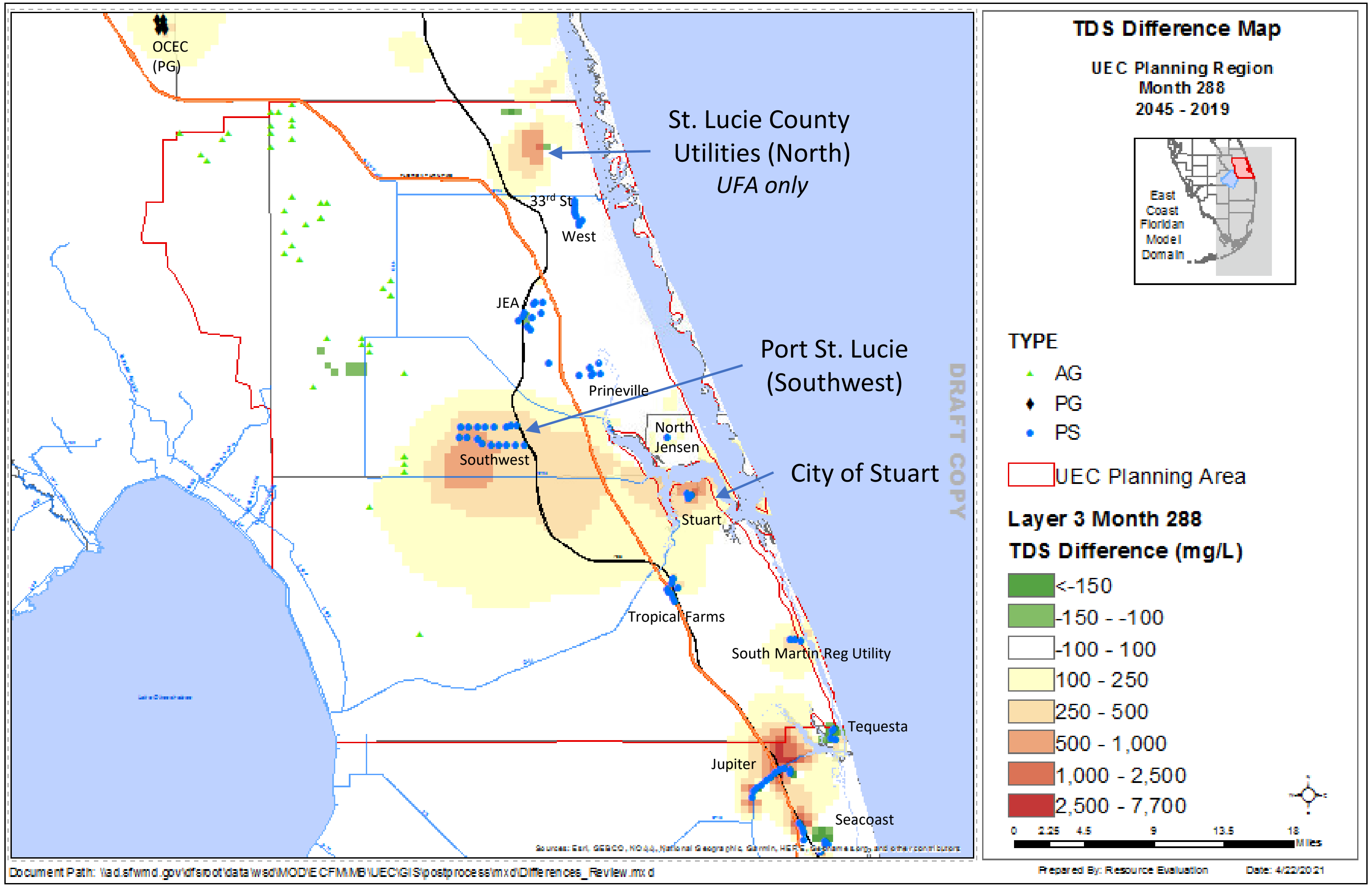
(2045 – 2019)



- ➢ Up to 3 ft of drawdown at St. Lucie County Utilities (North Wellfield)
  - 4 mgd UFA demand
- ➢ Approximately 2 ft of rebound at City of Port St. Lucie Utility Systems Department (JEA Wellfield)
  - 0.52 mgd decrease
- ➢ Approximately 1 ft of rebound in western St. Lucie County due to agricultural demand reduction

Avon Park Permeable Zone Water Quality Difference (2045 – 2019)

- St. Lucie County Utilities (North Wellfield)
  - No wells in the APPZ
  - TDS increases as high as 1,000 mg/L
- City of Port St. Lucie Utility Systems Department (Southwest Wellfield)
  - Increase in TDS as high as 700 mg/L
  - 2019 demand = 0 mgd
  - 2045 demand = 9.43 mgd
- City of Stuart
  - Increase in TDS as high as 1,040 mg/L
  - 2.6 mgd APPZ demand in 2045



St. Lucie County Utilities (North)
UFA only

Port St. Lucie (Southwest)

City of Stuart

TDS Difference Map

UEC Planning Region
Month 288
2045 - 2019

Layer 3 Month 288

TDS Difference (mg/L)

- 🟩 <-150
- 🟩 -150 - -100
- ☐ -100 - 100
- 🟨 100 - 250
- 🟧 250 - 500
- 🟧 500 - 1,000
- 🟥 1,000 - 2,500
- 🟥 2,500 - 7,700

Sources: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributors

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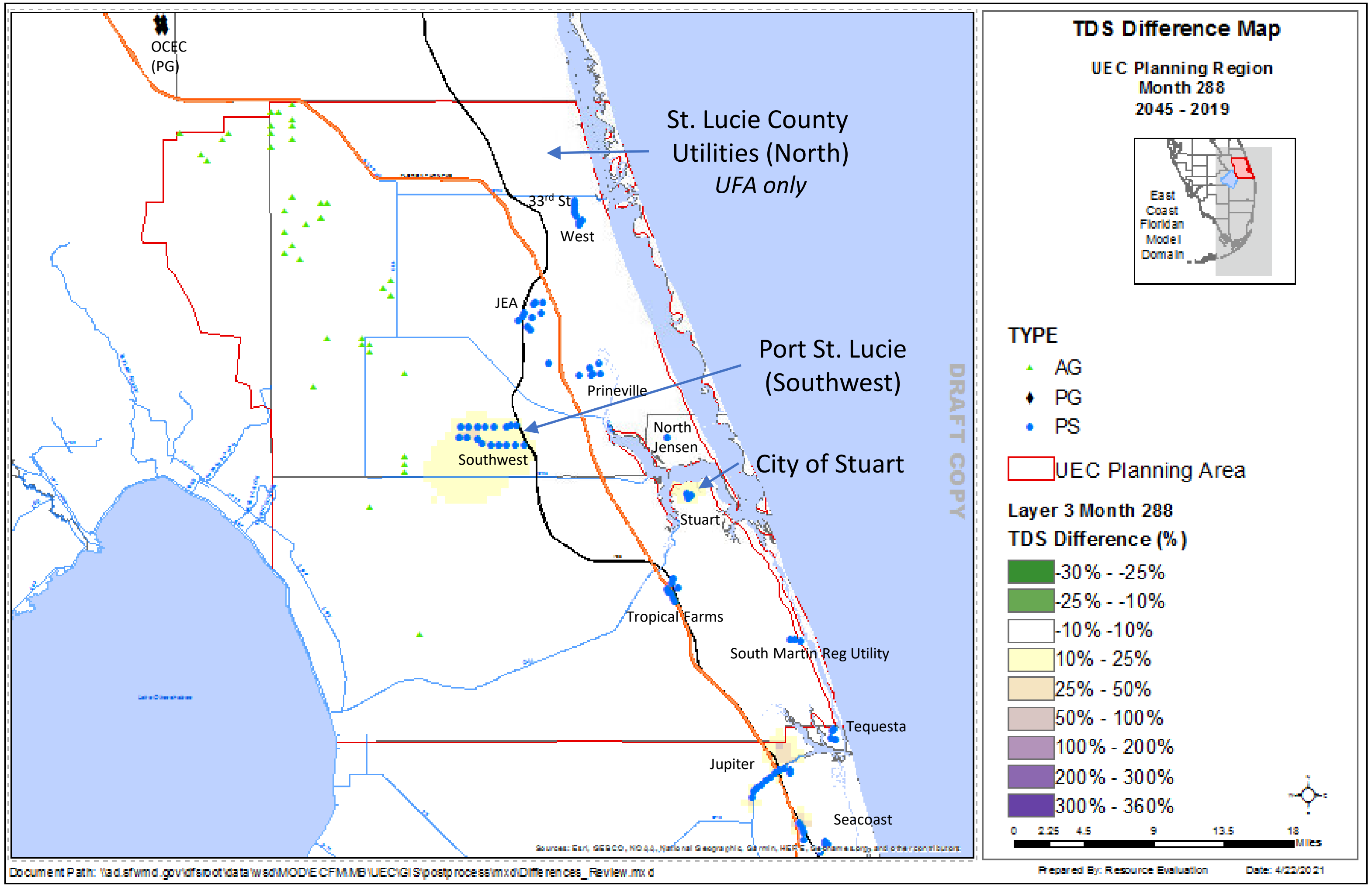
Prepared By: Resource Evaluation

Date: 4/22/2021

Avon Park Permeable Zone Water Quality % Difference (2045 – 2019)

- ➢ St. Lucie County Utilities (North Wellfield)
  - No wells in the APPZ
  - TDS increases ~5%
- ➢ City of Port St. Lucie Utility Systems Department (Southwest Wellfield)
  - Increase in TDS ~30%
  - 2019 demand = 0 mgd
  - 2045 demand = 9.43 mgd
- ➢ City of Stuart
  - Increase in TDS ~21%
  - 2.6 mgd APPZ demand in 2045



Sources: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributors

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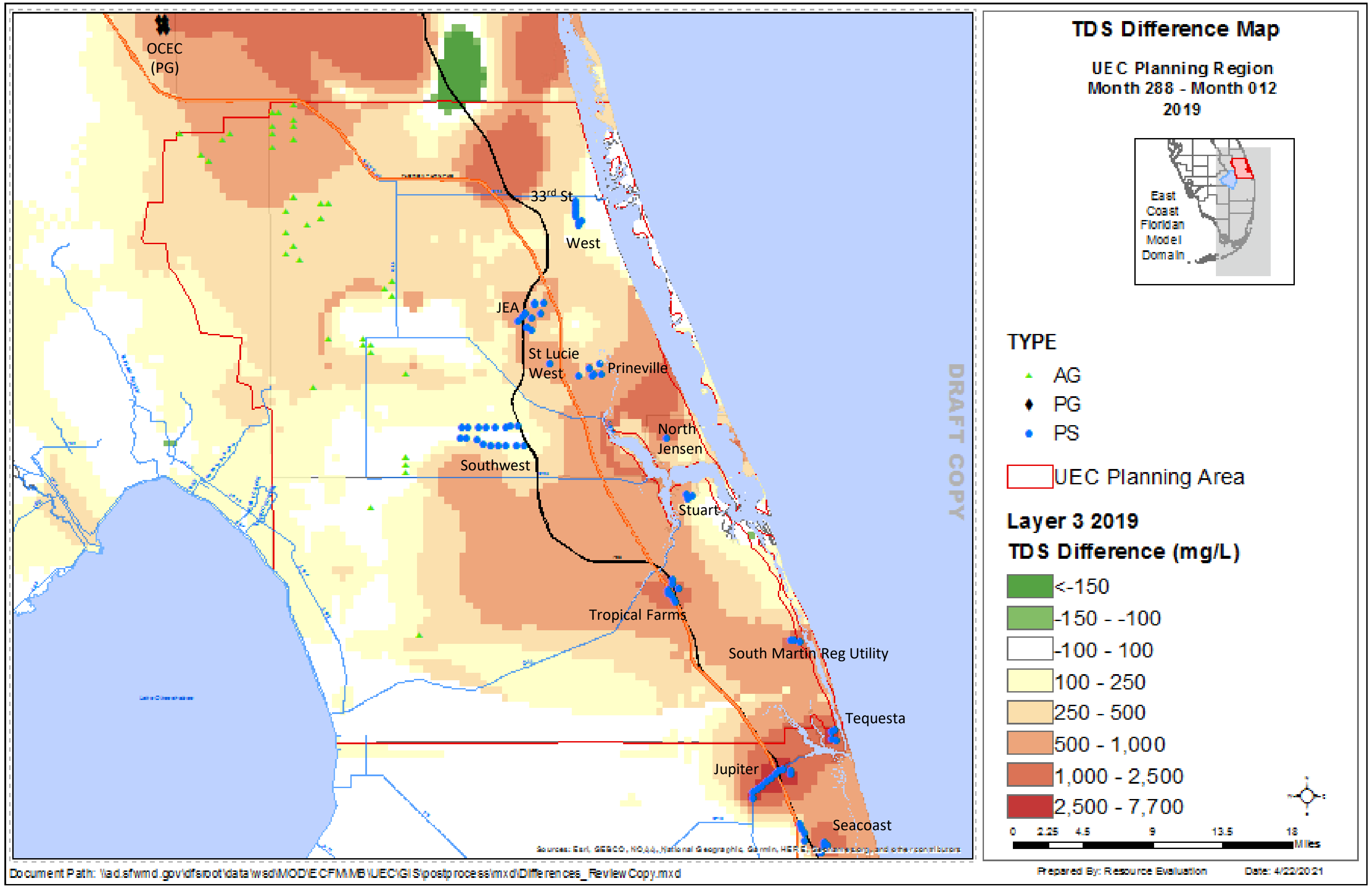
Prepared By: Resource Evaluation Date: 4/22/2021

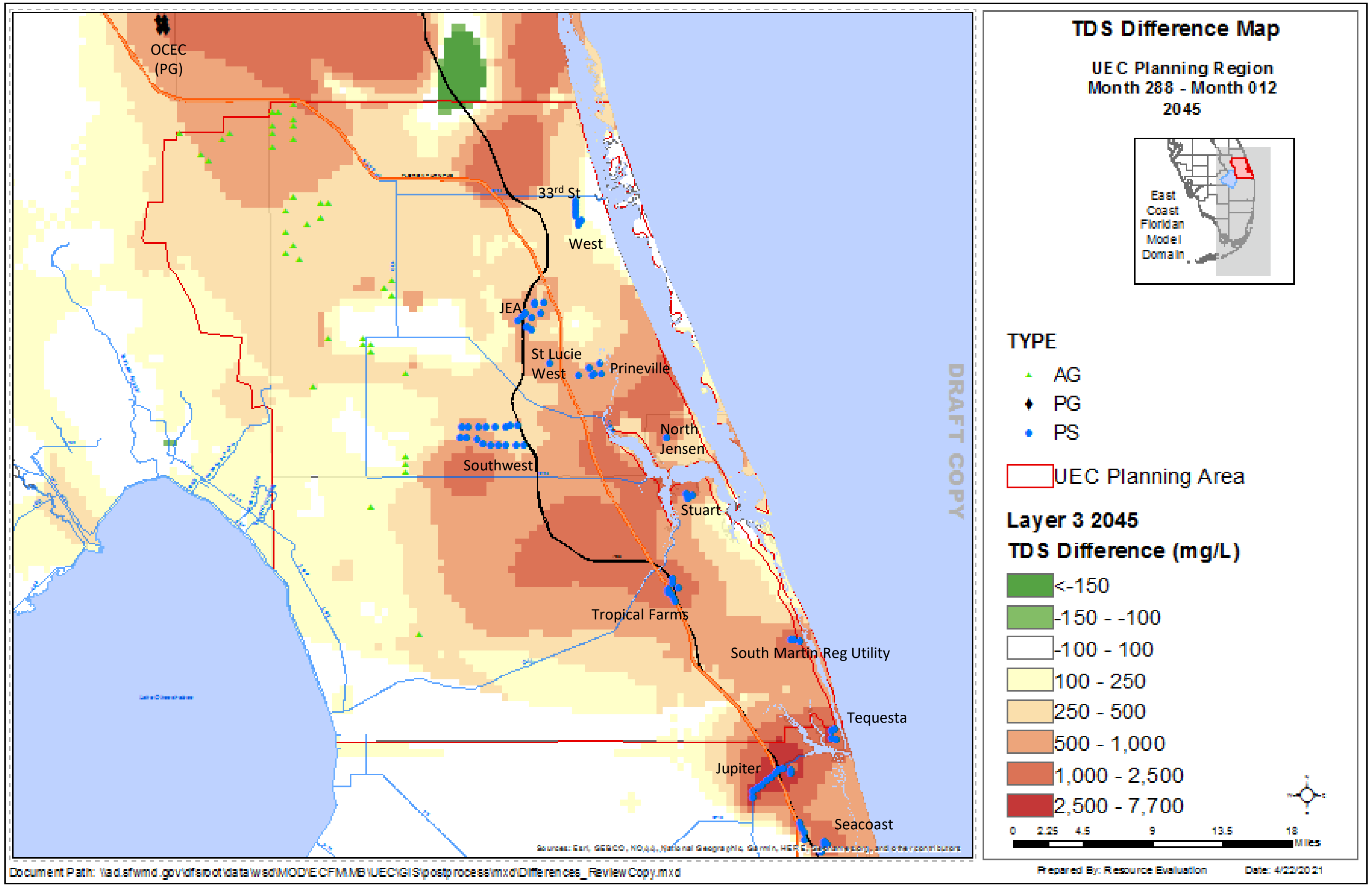
Avon Park Permeable Zone Water Quality Difference in 2019

- Difference in TDS concentrations within the ECFM **2019** scenario model run (Year 1 to 24)



Avon Park Permeable Zone Water Quality Difference in 2045

- Difference in TDS concentrations within the ECFM **2045** scenario model run (Year 1 to 24)



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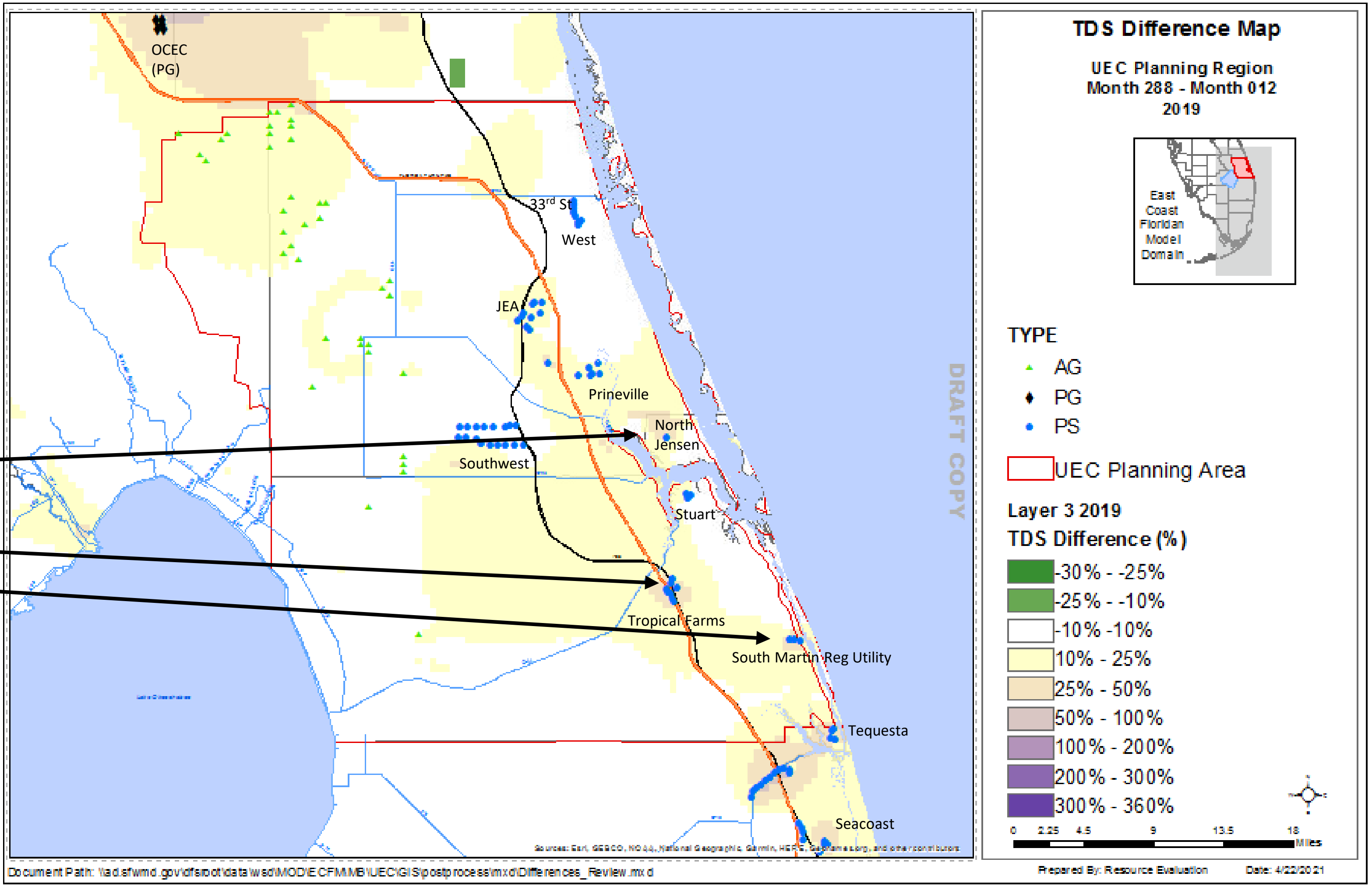
Prepared By: Resource Evaluation Date: 4/22/2021

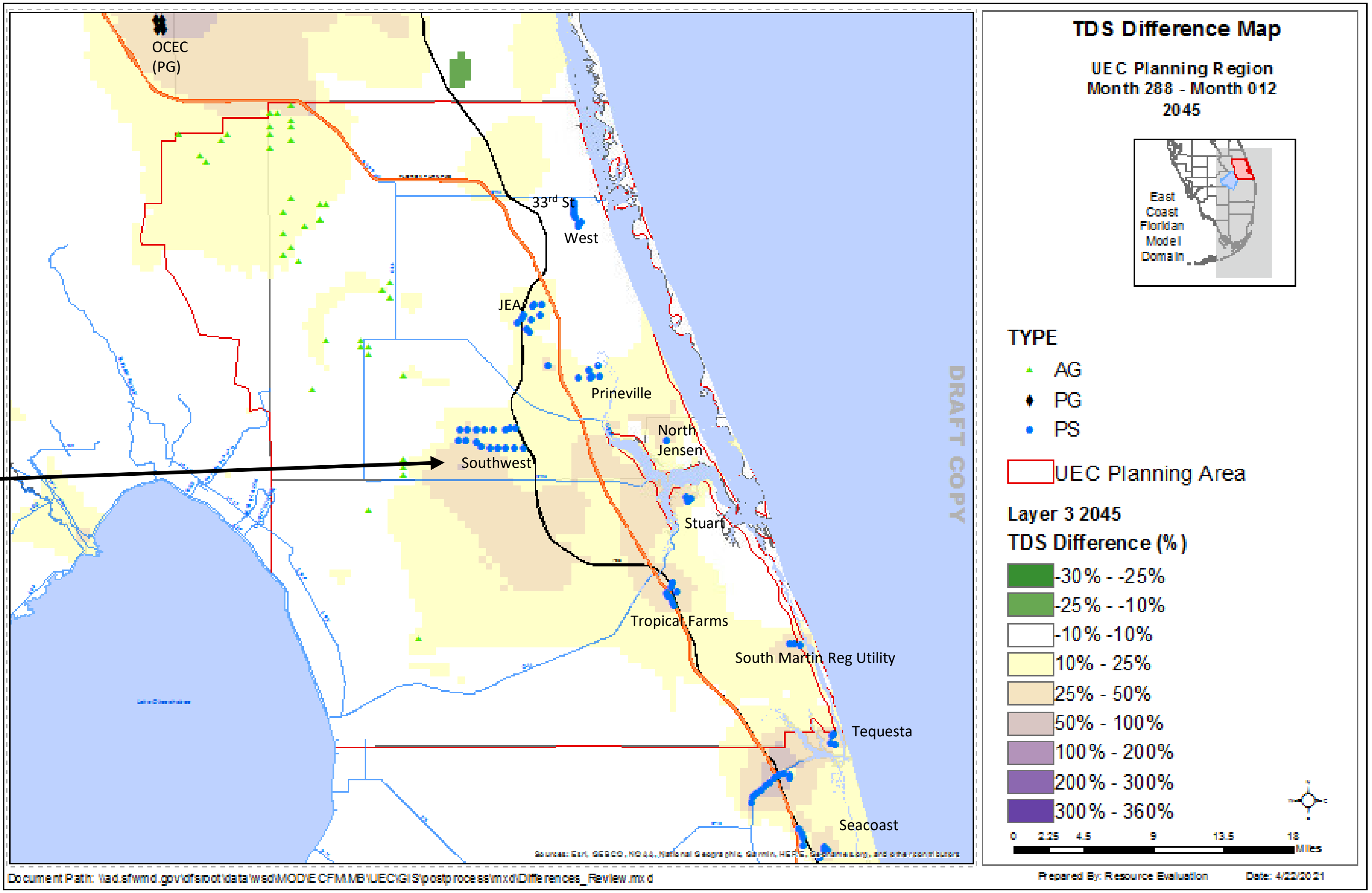
Avon Park Permeable Zone Water Quality % Difference in 2019

- % difference in TDS concentrations within the ECFM **2019** scenario model run (Year 1 to 24)
- % increase in TDS concentration within the UEC Planning Area ~30% at:
  - *North Jensen*
  - *Tropical Farms*
  - *South Martin Regional Utility*



Avon Park Permeable Zone Water Quality % Difference in 2045

- % difference in TDS concentrations within the ECFM **2045** scenario model run (Year 1 to 24)
- Highest % increase in TDS concentration within the UEC Planning Area ~50% near City of Port St. Lucie's Southwest Wellfield
  - *2045 demand = 9.43 mgd*



Sources: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributors

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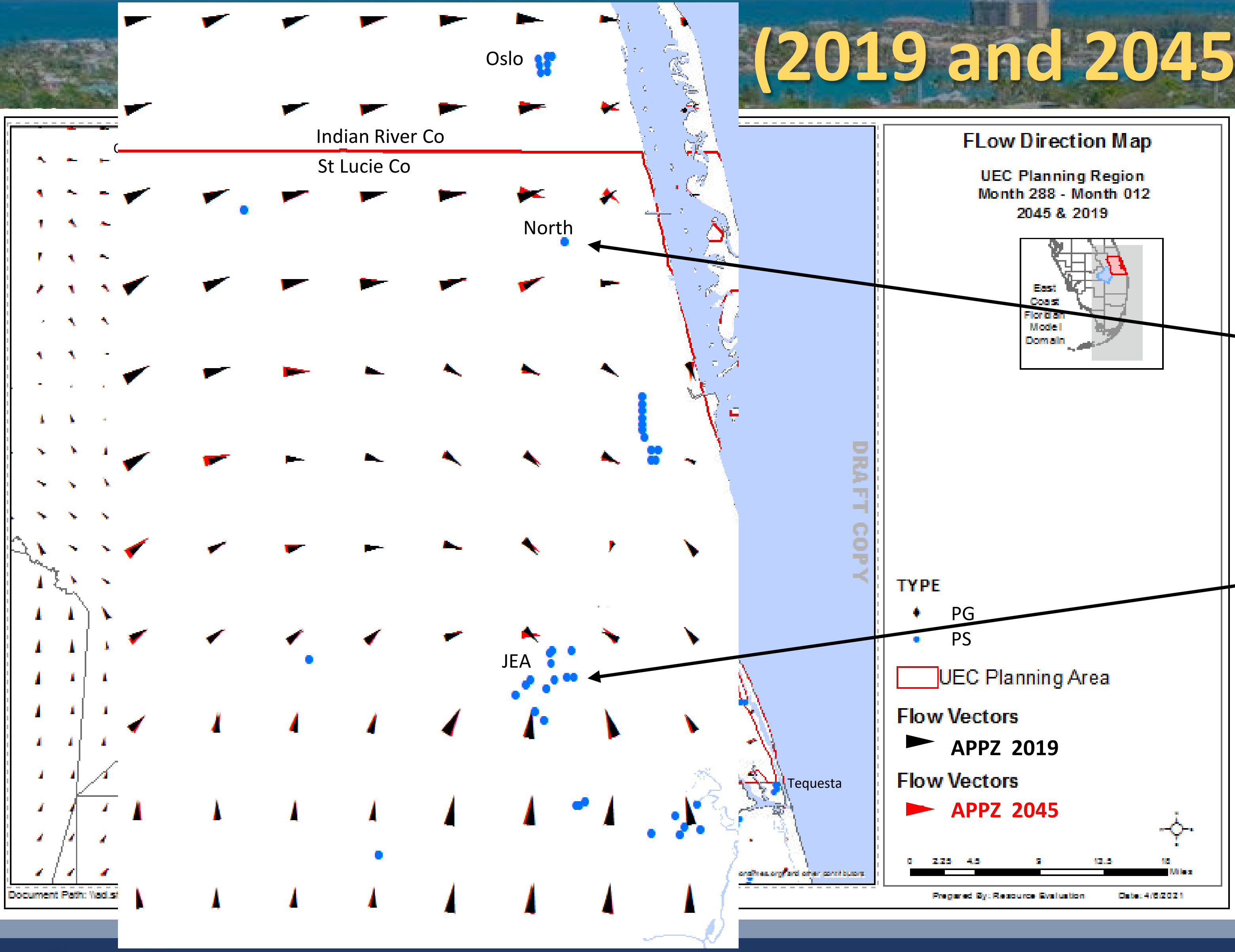
Prepared By: Resource Evaluation Date: 4/22/2021

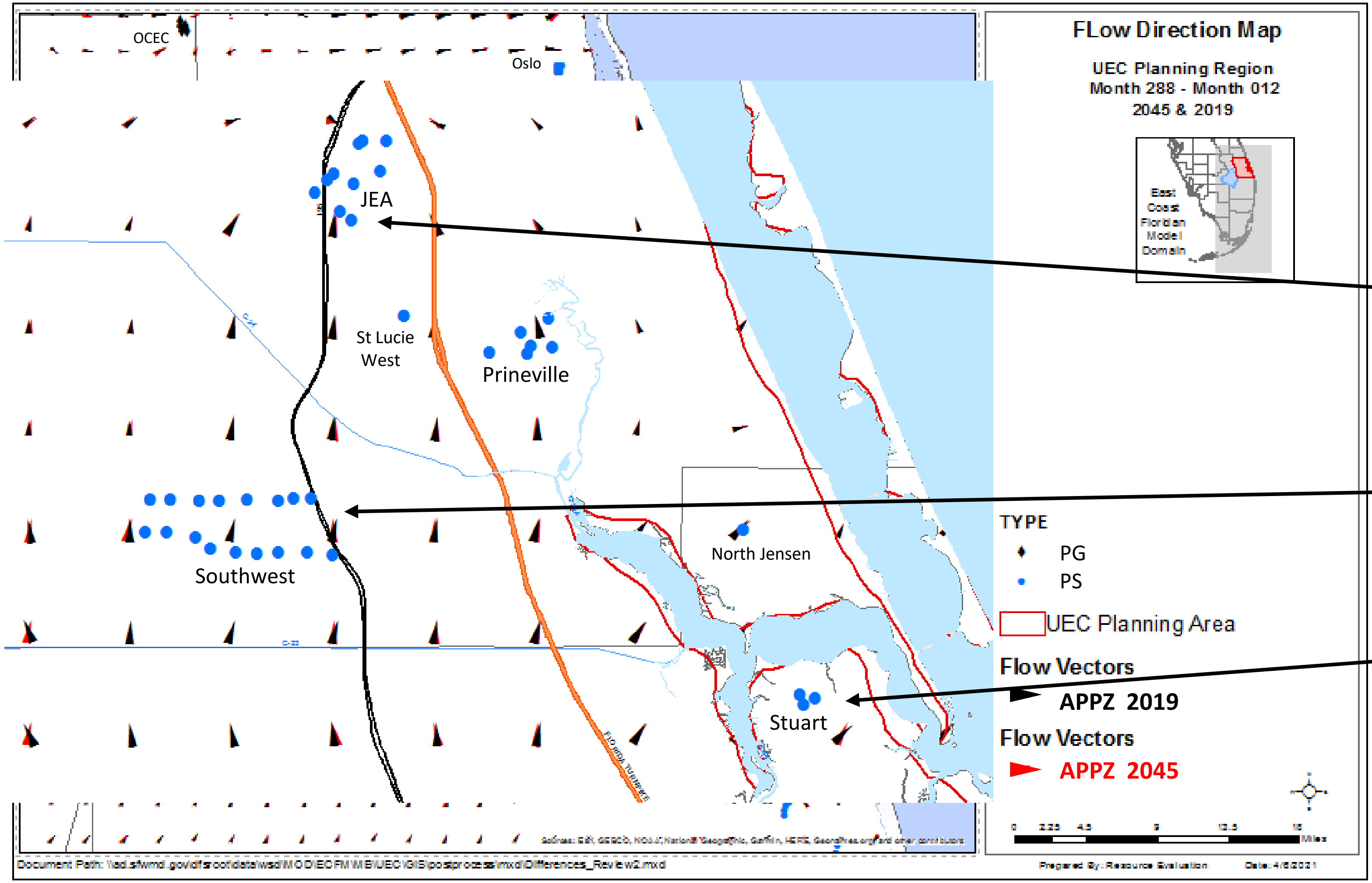
Avon Park Permeable Zone Horizontal Flow Vectors (2019 and 2045)



- Differences in flow direction and magnitude can be seen at:
  - St. Lucie County Utilities (North Wellfield – pumping from UFA)
    - Increase in horizontal flow from the western area
  - City of Port St. Lucie Utility Systems Dept. (JEA Wellfield)
    - Slight increase in horizontal flow from the surrounding area *plus slight turn away*
    - 0.5 mgd decrease in APPZ demand

Vectors represent horizontal flow averaged over 25 model cells

Avon Park Permeable Zone Horizontal Flow Vectors (2019 and 2045)


OCEC
Oslo
JEA
St Lucie West
Prineville
Southwest
North Jensen
Stuart
FLOW Direction Map
UEC Planning Region
Month 288 - Month 012
2045 & 2019
East Coast Floridan Model Domain
TYPE
♦ PG
● PS
🟥 UEC Planning Area
Flow Vectors
APPZ 2019
Flow Vectors
APPZ 2045
0 2.25 4.5 9 13.5 18 Miles
Sources: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributors
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Prepared By: Resource Evaluation
Date: 4/6/2021

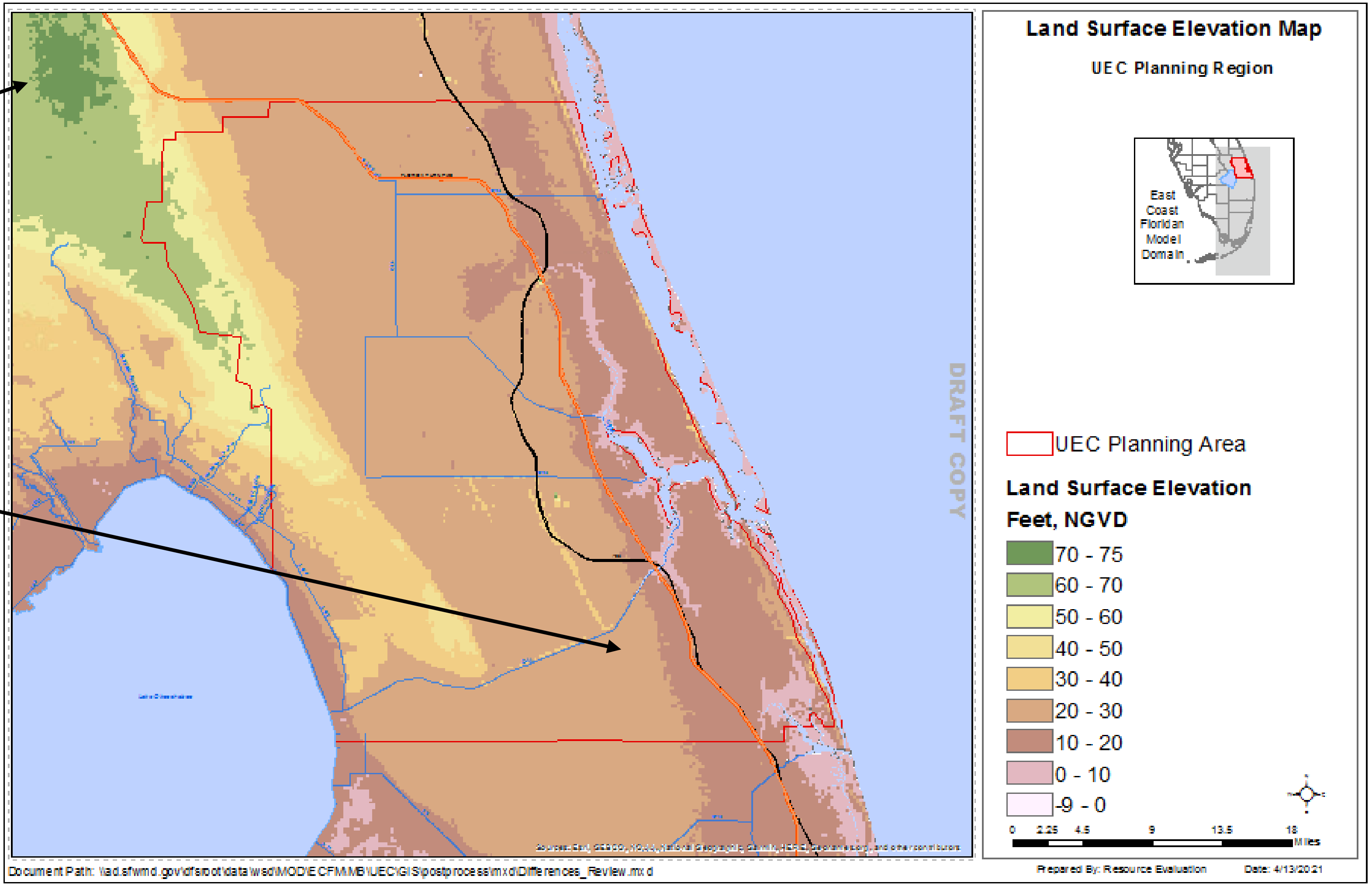
- Differences in flow direction and magnitude can be seen at:
  - City of Port St. Lucie Utility Systems Department (JEA Wellfield)
    - Slight increase in horizontal flow from the surrounding area
    - ~0.5 mgd decrease in APPZ demand
  - City of Port St. Lucie Utility Systems Department (Southwest Wellfield)
    - Only slight change in horizontal flow despite 9.43 mgd increase in APPZ demand
  - City of Stuart
    - Slight change in flow direction towards the wellfield
    - 2.6 mgd from the APPZ in 2045

Vectors represent horizontal flow averaged over 25 model cells

Artesian Head Relative to the Upper Floridan Aquifer

Land Surface Elevation

- Green shows ridge area with higher elevations
- Elevations decrease to the east and southeast


Land Surface Elevation Map
UEC Planning Region
East Coast Floridan Model Domain
DRAFT COPY
UEC Planning Area
Land Surface Elevation
Feet, NGVD
70 - 75
60 - 70
50 - 60
40 - 50
30 - 40
20 - 30
10 - 20
0 - 10
-9 - 0
0
2.25
4.5
9
13.5
18
Miles
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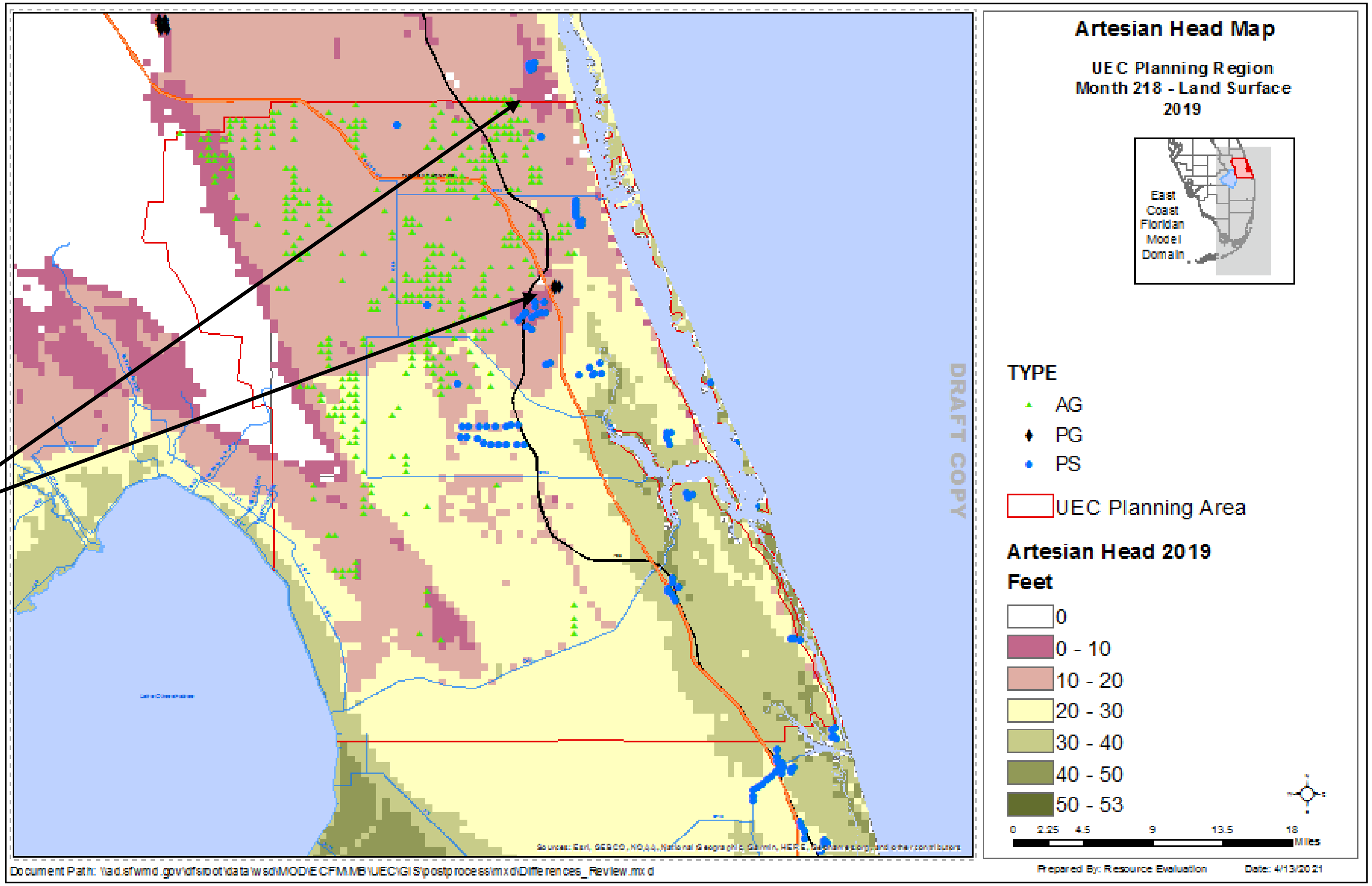
Prepared By: Resource Evaluation
Date: 4/13/2021

Upper Floridan Artesian Head 2019

- Simulated UFA head (month 218) minus land surface elevation
- Month 218 (February 2007) = dry month (1-in-10 drought condition)
- Lower artesian heads in areas of PS pumping



Sources: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributors

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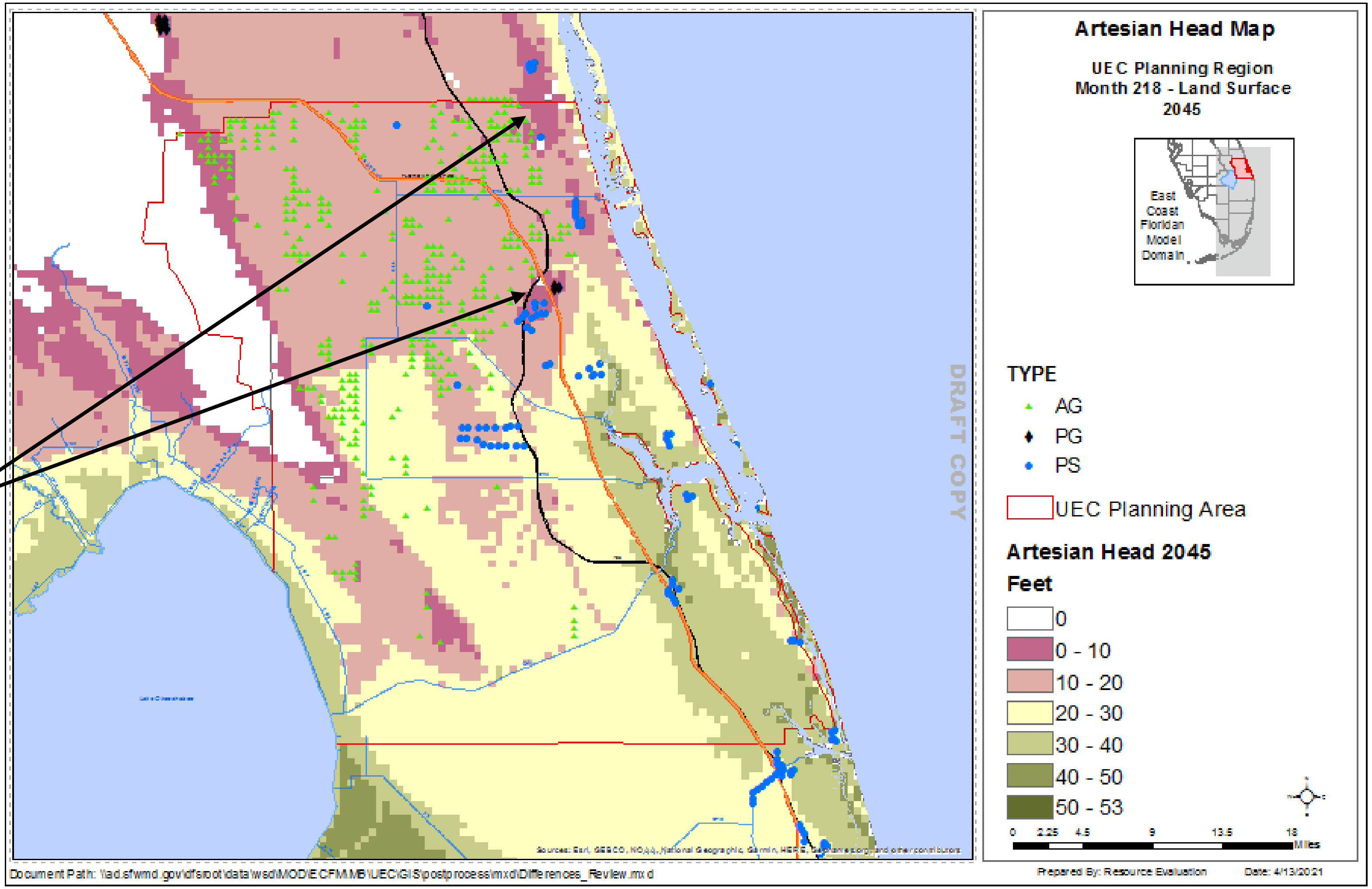
Prepared By: Resource Evaluation

Date: 4/13/2021

Upper Floridan Artesian Head 2045

- Simulated UFA head (month 218) minus land surface elevation
- Month 218 (February 2007) = dry month (1-in-10 drought condition)
- Lower artesian heads in areas of PS/PG pumping


Artesian Head Map
UEC Planning Region
Month 218 - Land Surface
2045
East Coast Floridan Model Domain
TYPE
AG
PG
PS
UEC Planning Area
Artesian Head 2045
Feet
0
0 - 10
10 - 20
20 - 30
30 - 40
40 - 50
50 - 53
0
2.25
4.5
9
13.5
18
Miles
DRAFT COPY
Sources: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributors
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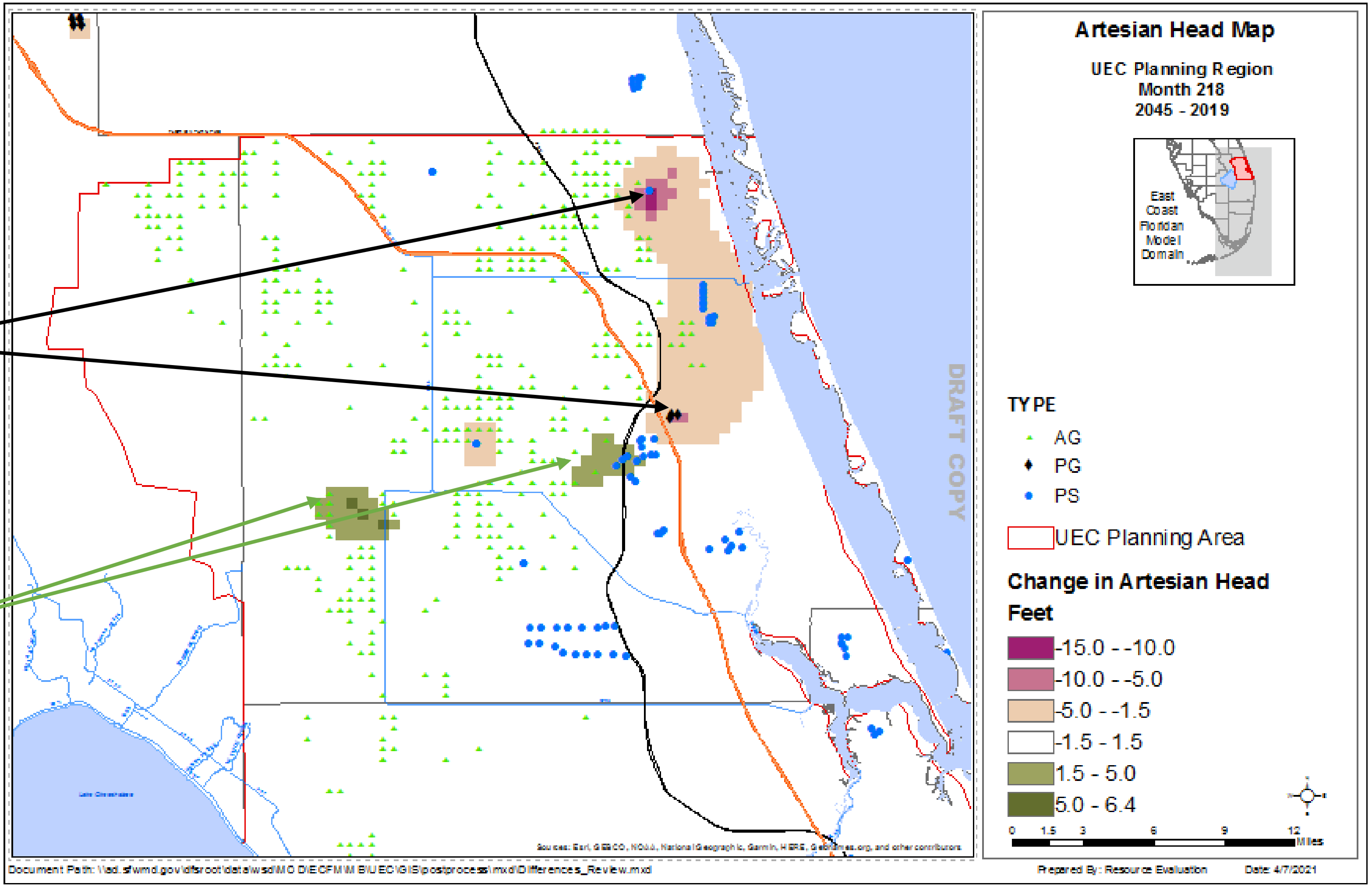
Prepared By: Resource Evaluation
Date: 4/13/2021

Change in Upper Floridan Artesian Head

(2045 minus 2019)

- Month 218 (February 2007) = dry month (1-in-10 drought condition)
- Significant decrease in artesian head in areas of increasing PS/PG pumping
  - NO artesian head near St. Lucie County North PS wells
- Slight increase in artesian head in areas of decreasing AG/PS pumping


Artesian Head Map
UEC Planning Region
Month 218
2045 - 2019
East Coast Floridan Model Domain
DRAFT COPY
TYPE
AG
PG
PS
UEC Planning Area
Change in Artesian Head
Feet
-15.0 - -10.0
-10.0 - -5.0
-5.0 - -1.5
-1.5 - 1.5
1.5 - 5.0
5.0 - 6.4
0 1.5 3 6 9 12 Miles
Sources: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributors
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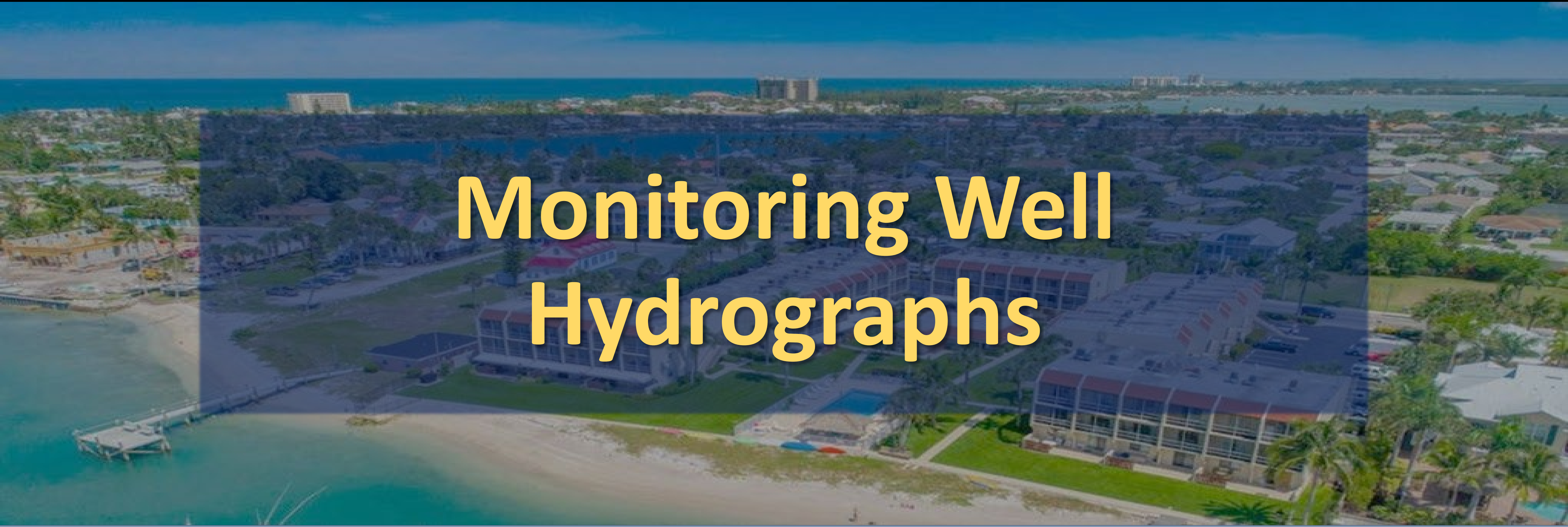
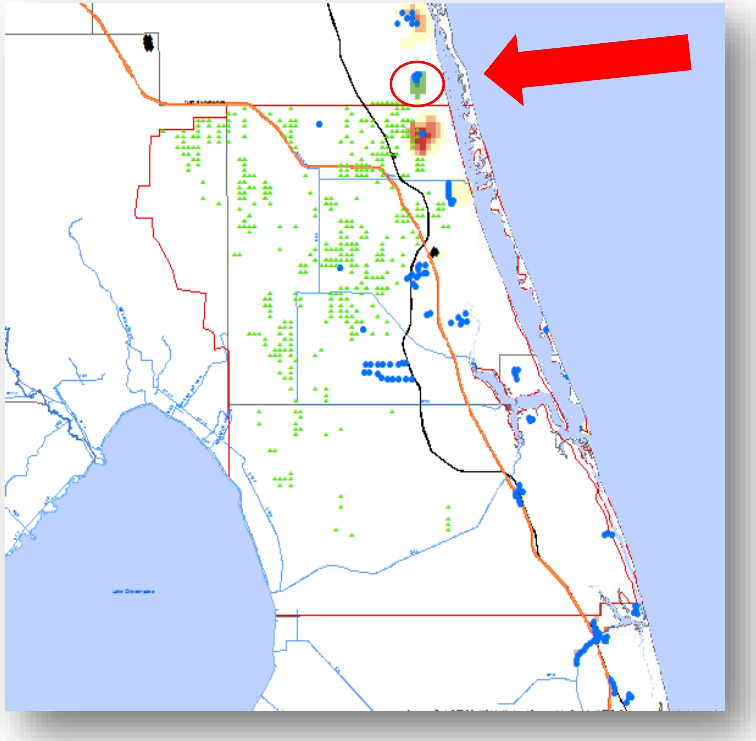
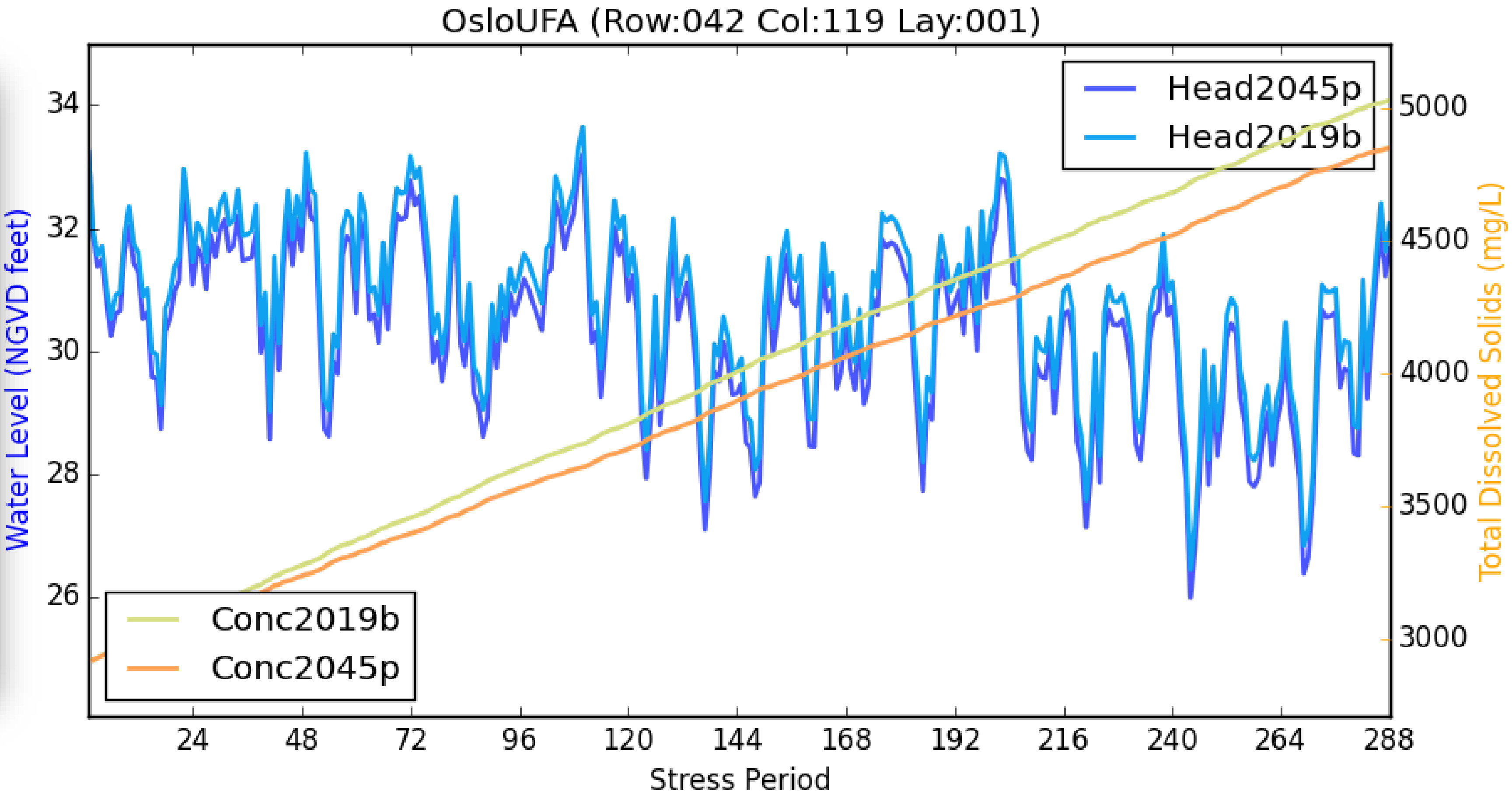
Prepared By: Resource Evaluation
Date: 4/7/2021



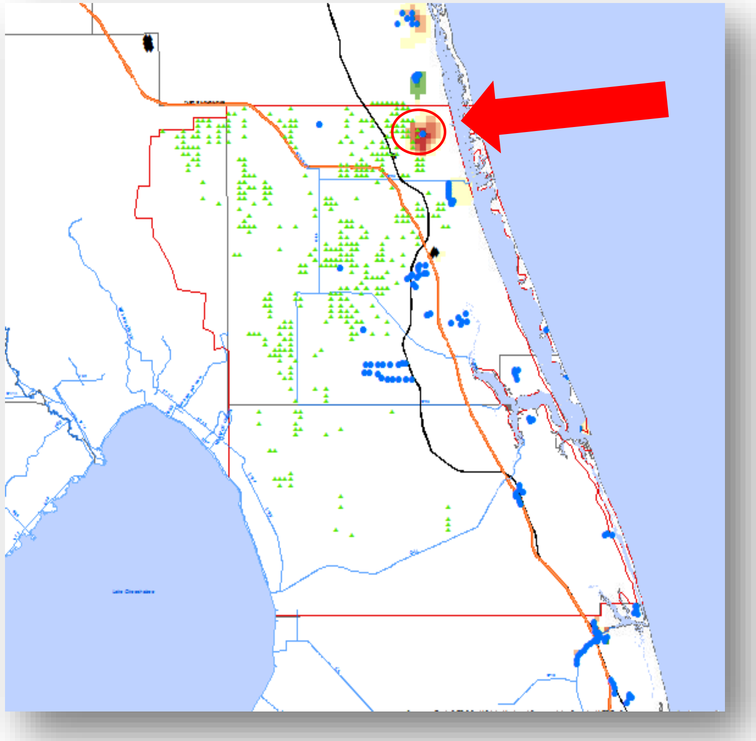
Monitoring Well Hydrographs

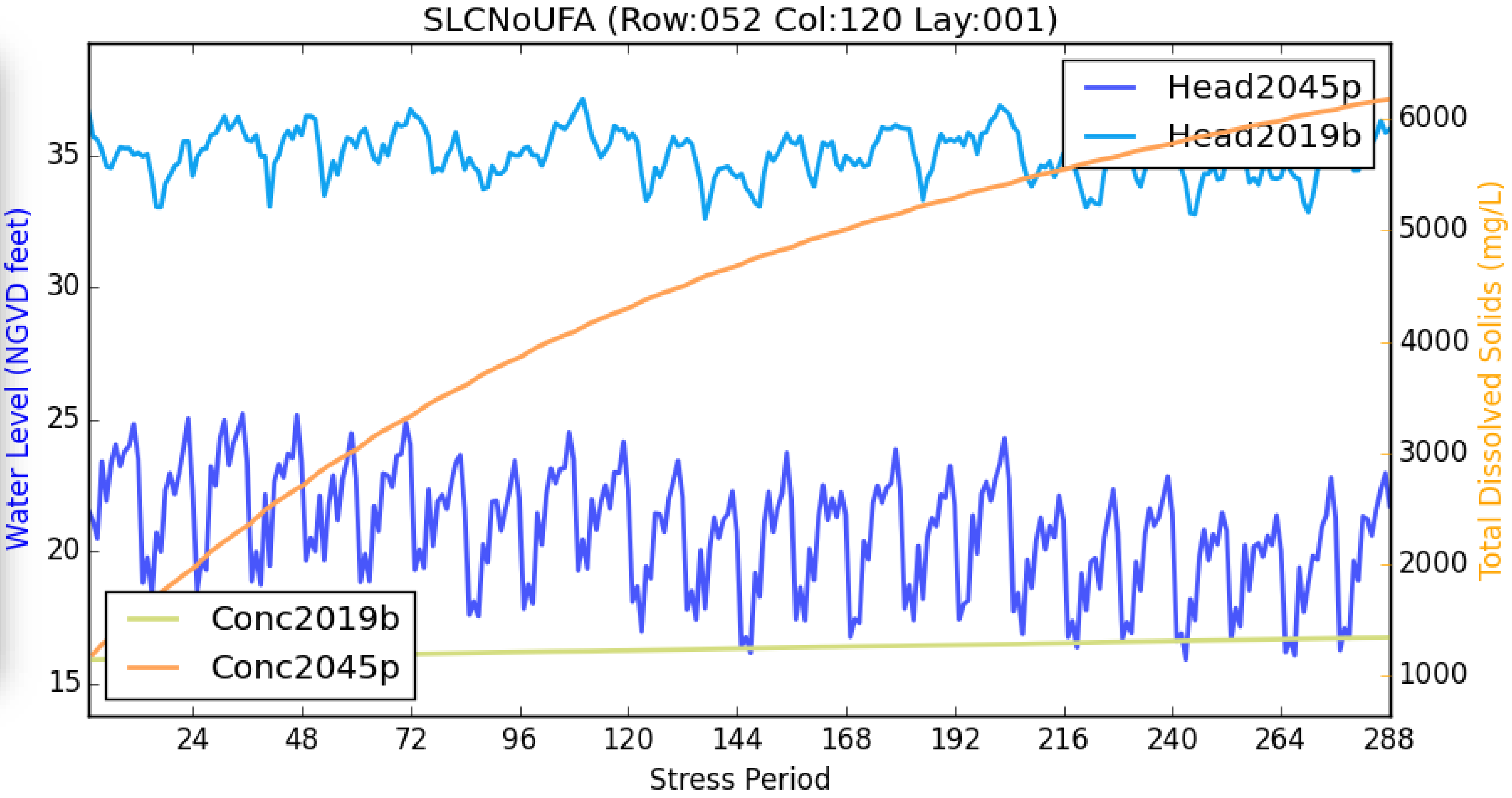
Upper Floridan Aquifer Near Oslo WTP



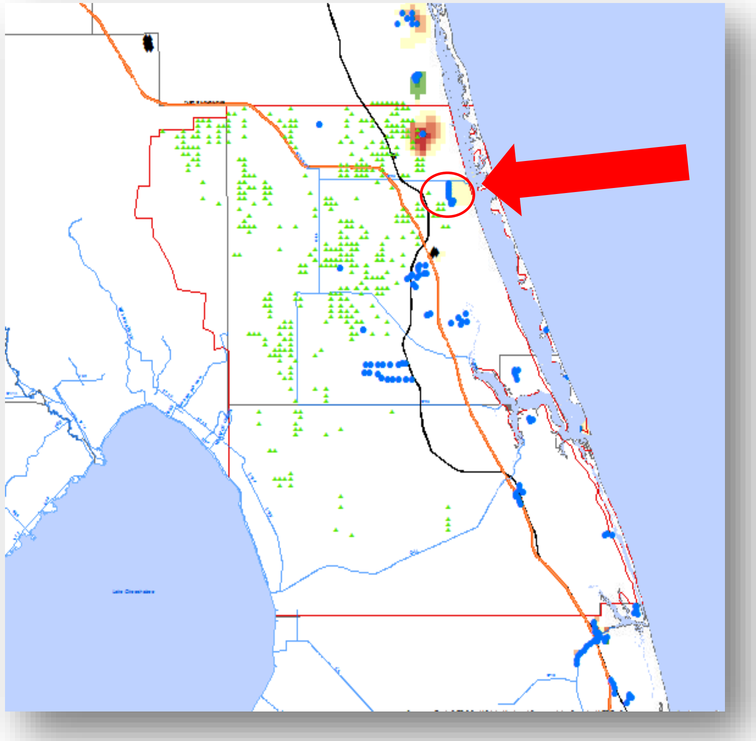


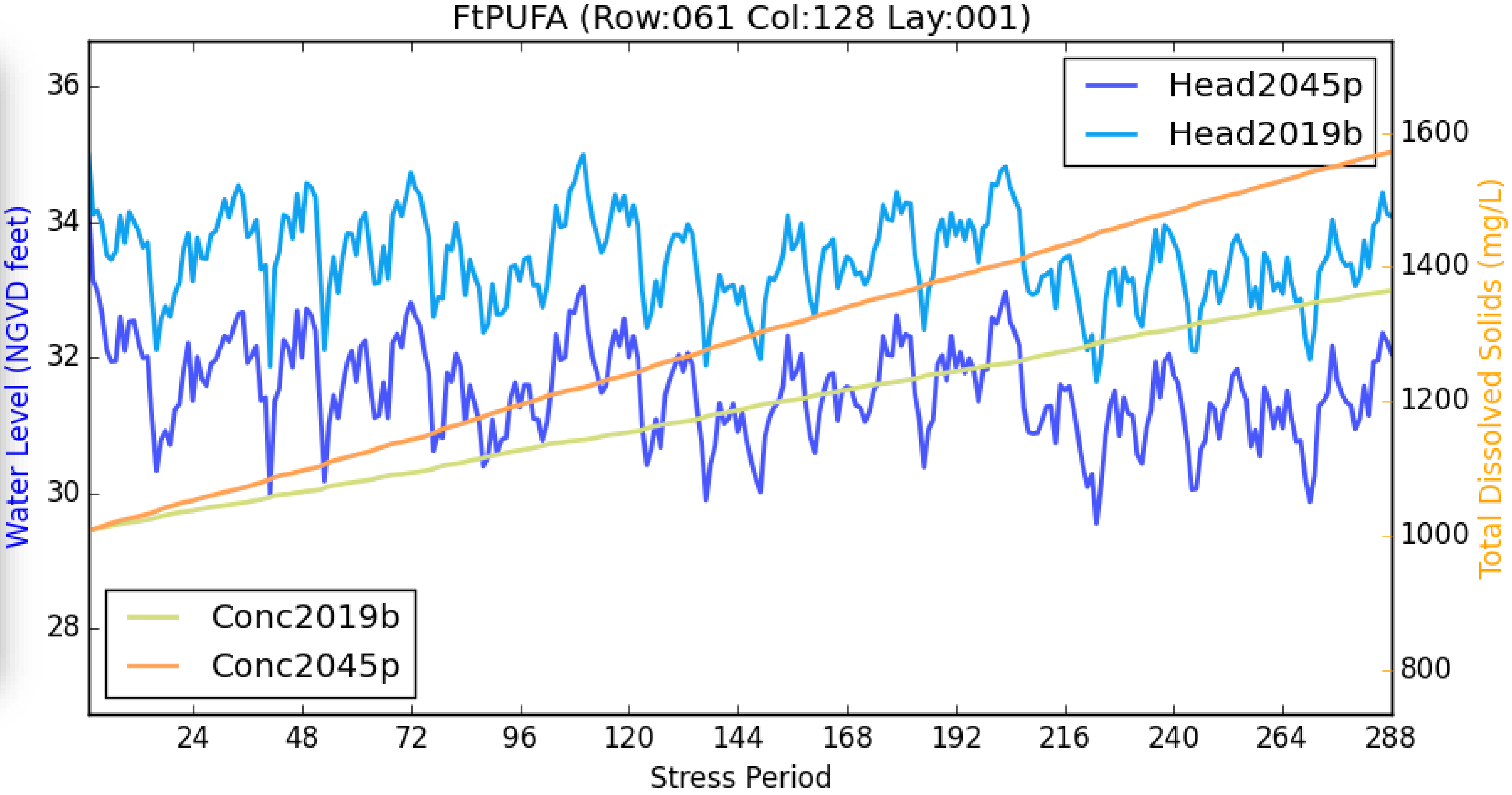
Upper Floridan Aquifer Near St. Lucie County Utilities (North Wellfield)



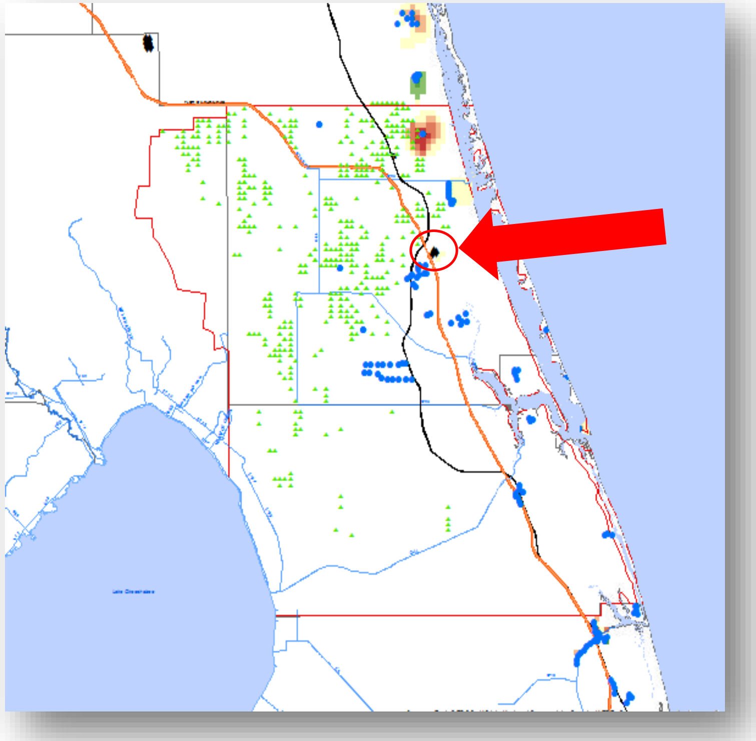


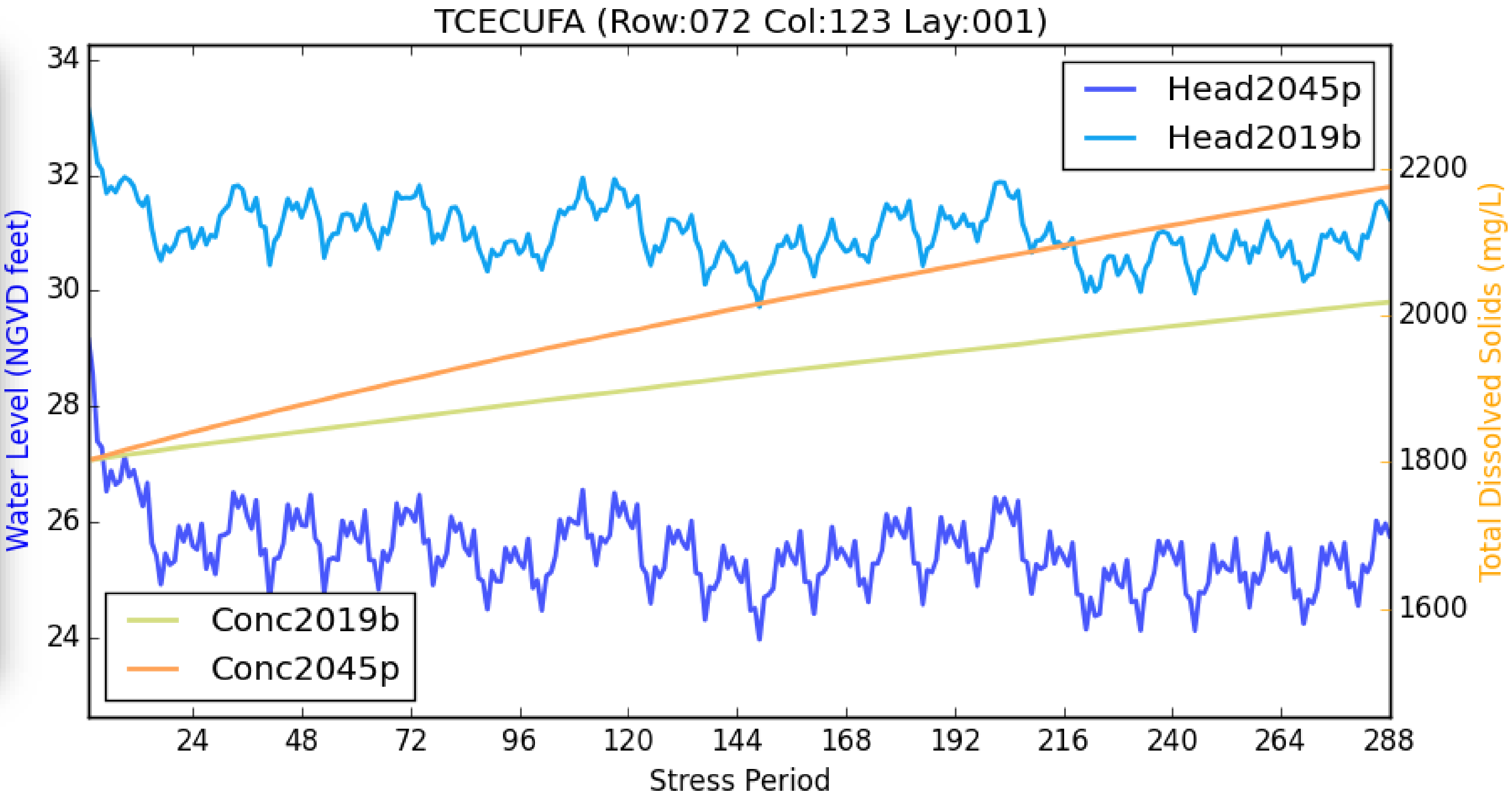
Upper Floridan Aquifer Near Fort Pierce Utilities Authority



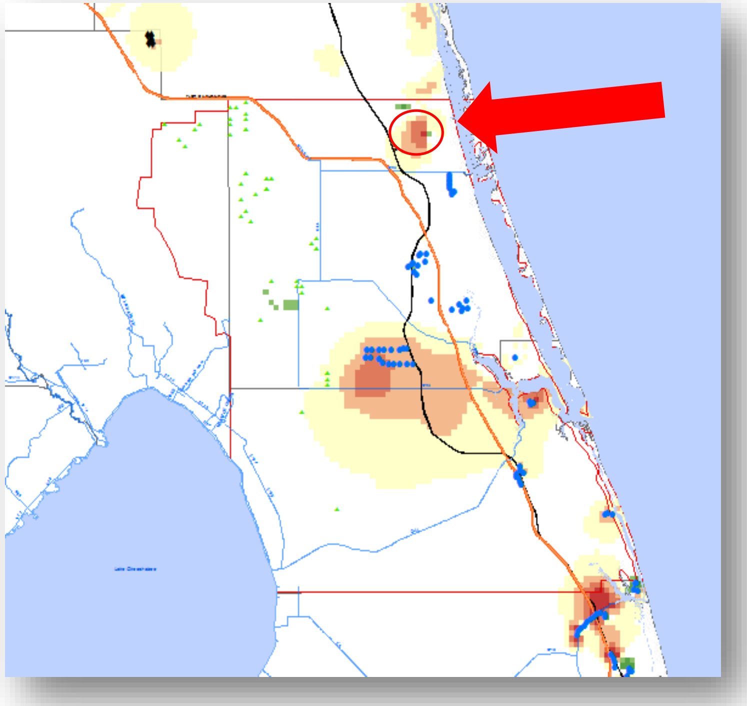


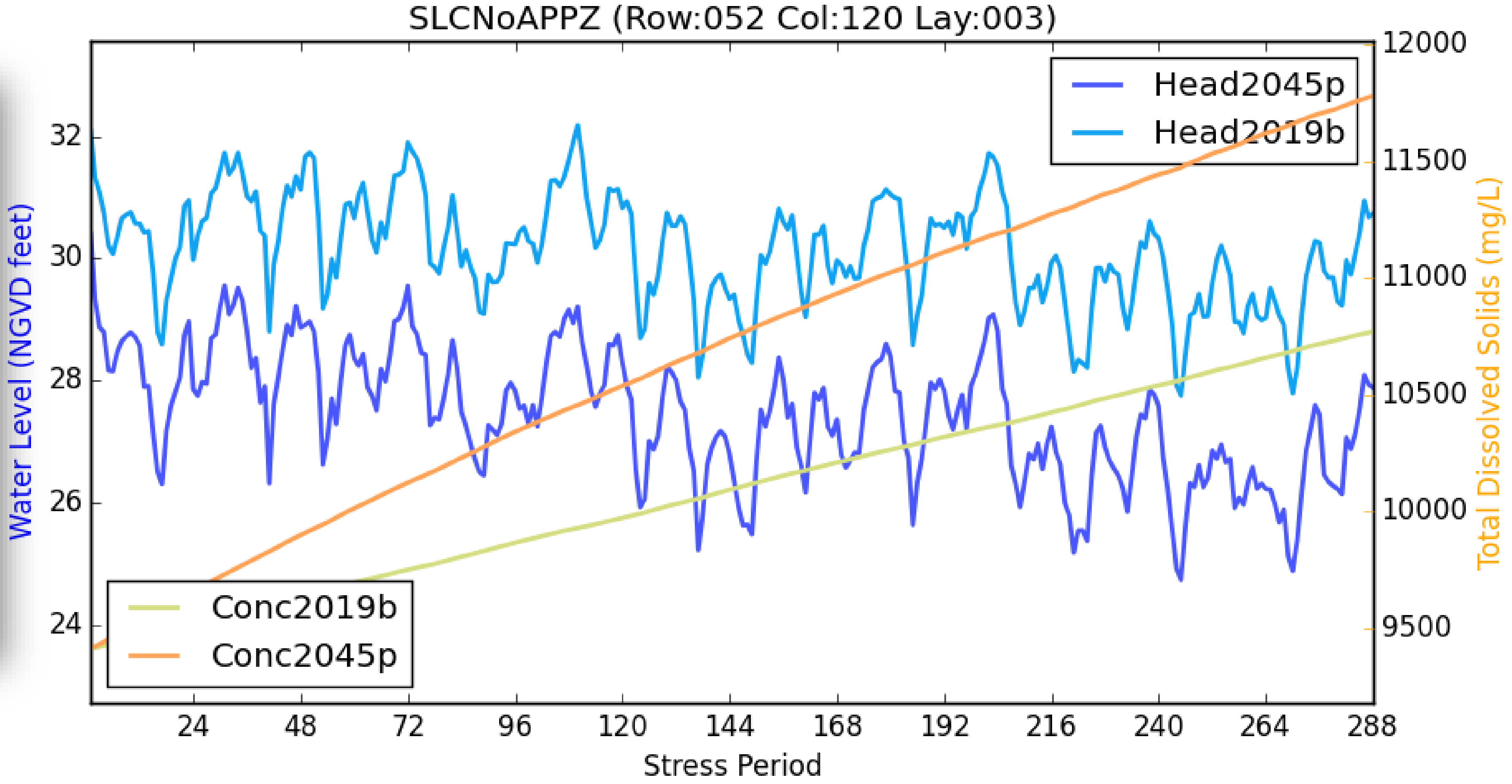
Upper Floridan Aquifer Near Treasure Coast Energy Center Power Generation Wells



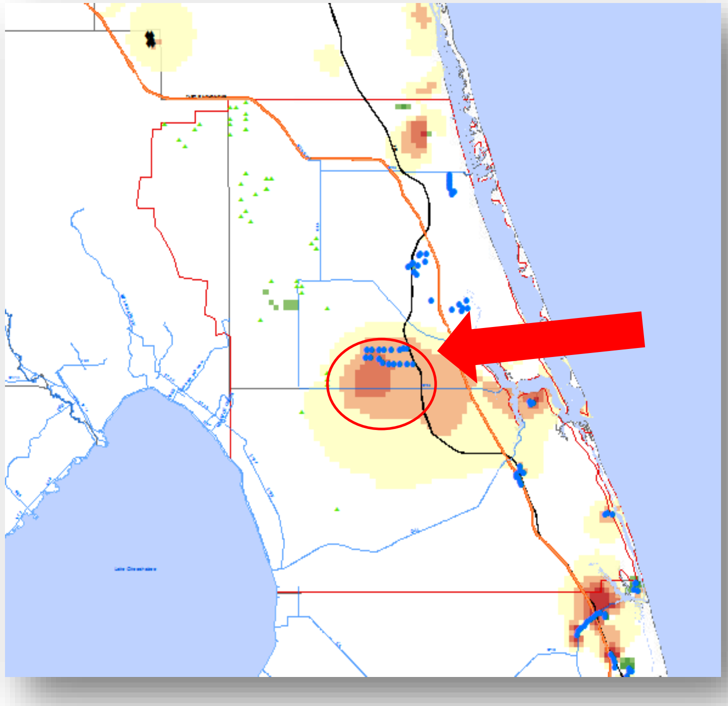


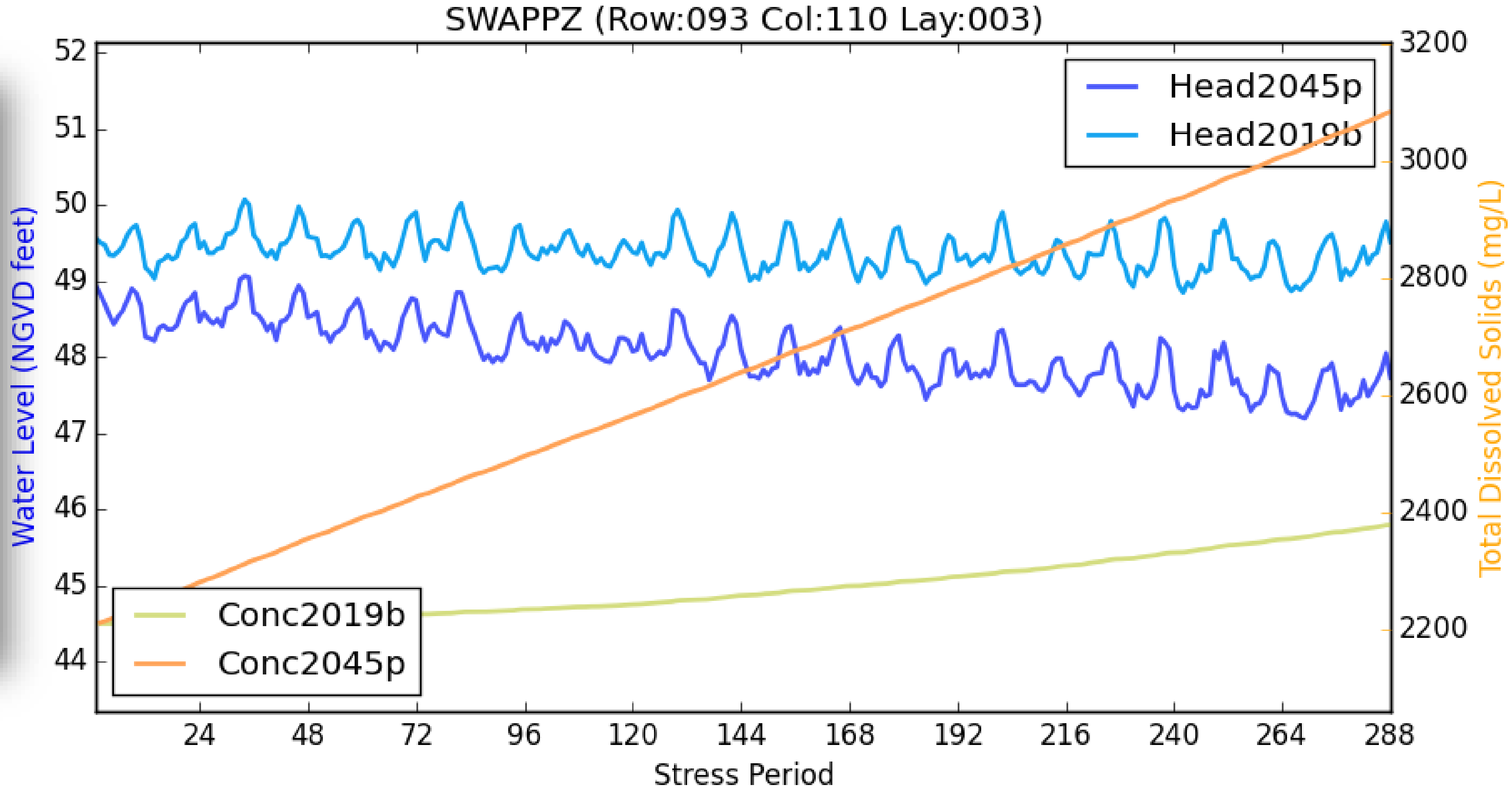
Avon Park Permeable Zone Near St. Lucie County Utilities (North Wellfield)



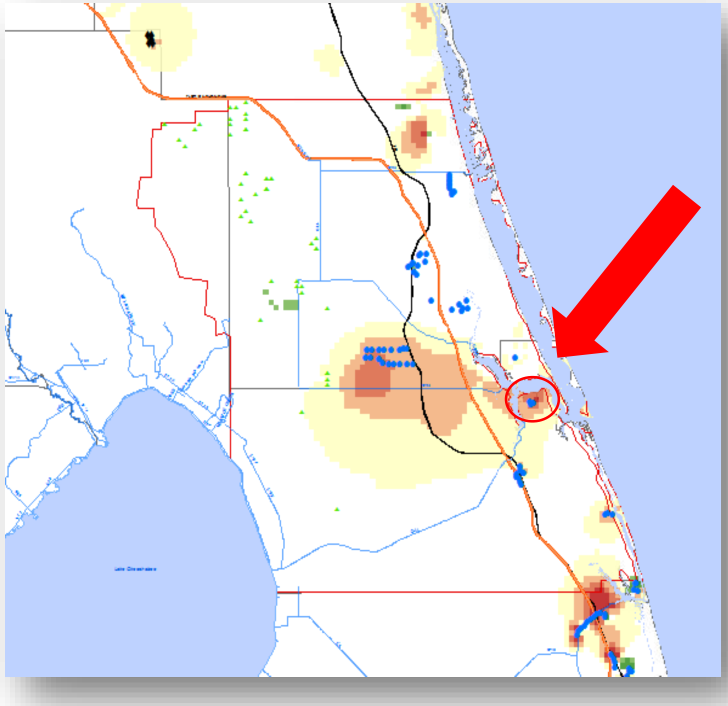


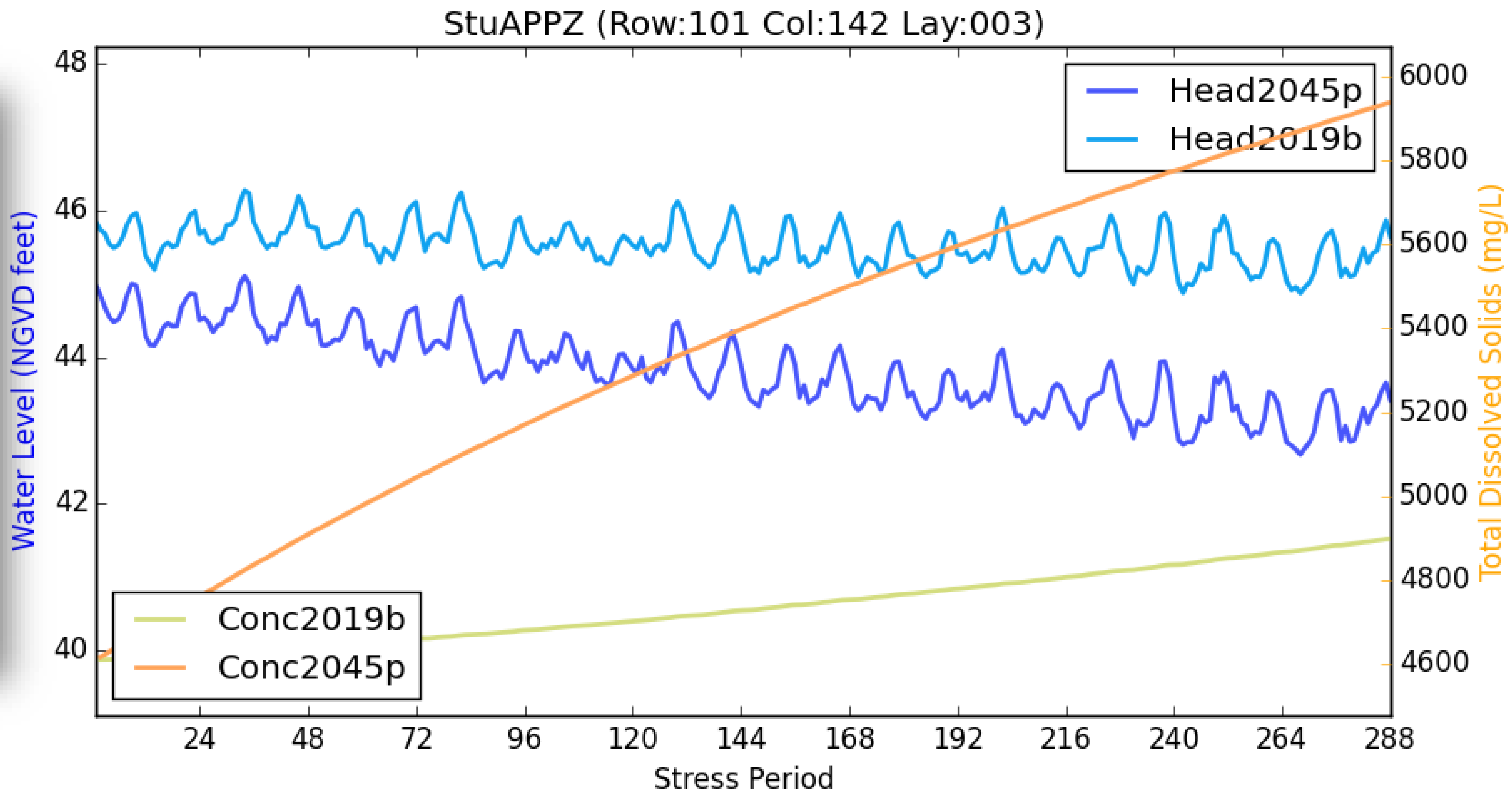
Avon Park Permeable Zone Near City of Port St. Lucie Utility Systems Department (Southwest Wellfield)





Avon Park Permeable Zone Near City of Stuart Wellfield





Model Conclusions

- Water Levels
  - UFA – Except for northeastern St. Lucie County, predicted drawdown in most of the UFA are less than 2.5 ft
  - APPZ – Less than 1.5 ft of drawdown predicted throughout the UEC Planning Area, except in northeastern St. Lucie County where a 3 ft decrease predicted
- Water Quality
  - UFA – Except for northeastern St. Lucie County, predicted TDS changes in the UFA are less than 250 mg/L
  - APPZ
    - Potential upward movement of APPZ water into the UFA may degrade water quality in northeastern St. Lucie County
    - 700-1,040 mg/L increase in TDS predicted at City of Port St. Lucie's Southwest Wellfield, City of Stuart, and St. Lucie County Utilities North Wellfield; less than 250 mg/L everywhere else
- FAS appears capable of meeting projected demands of all users through 2045 with appropriate wellfield management

Modeling Team

- Mirza Billah, Ph.D., E.I.T.
- Robert Earle
- Uditha Bandara, Ph.D., P.E.

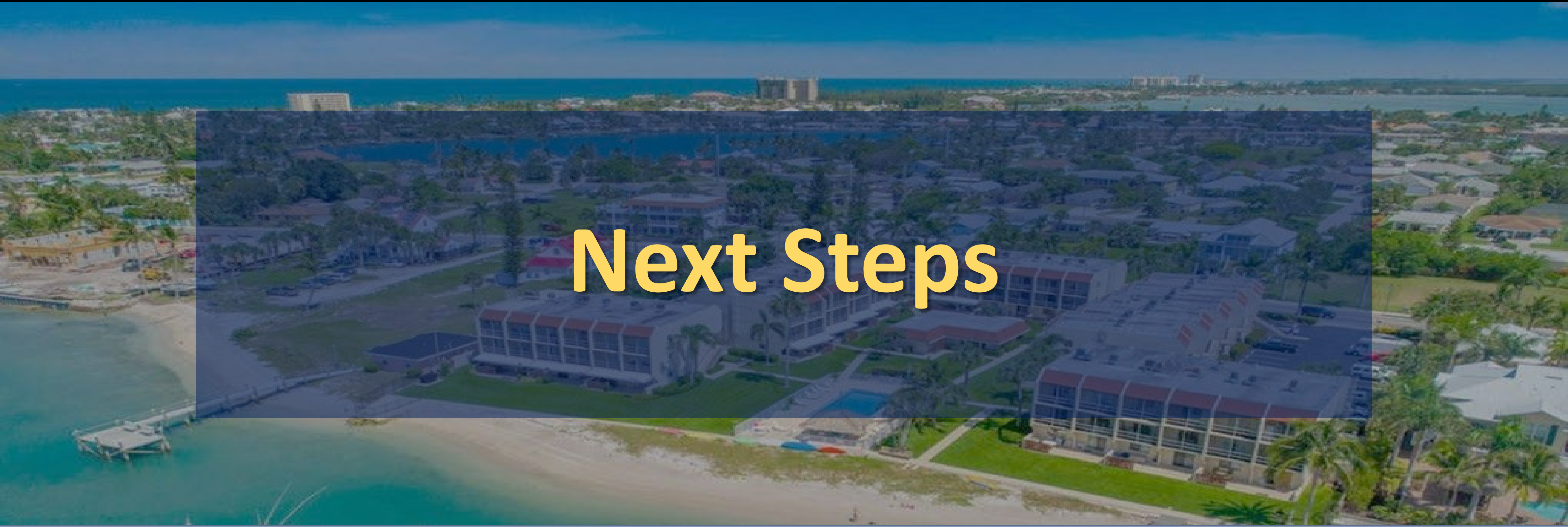
Thank You

Questions and Public Comment

If you are participating via Zoom: Use the Raise Hand feature

If you are participating via phone: *9 raises hand, *6 mutes/unmutes

When you are called on, please state your full name and affiliation prior to providing comments and/or questions



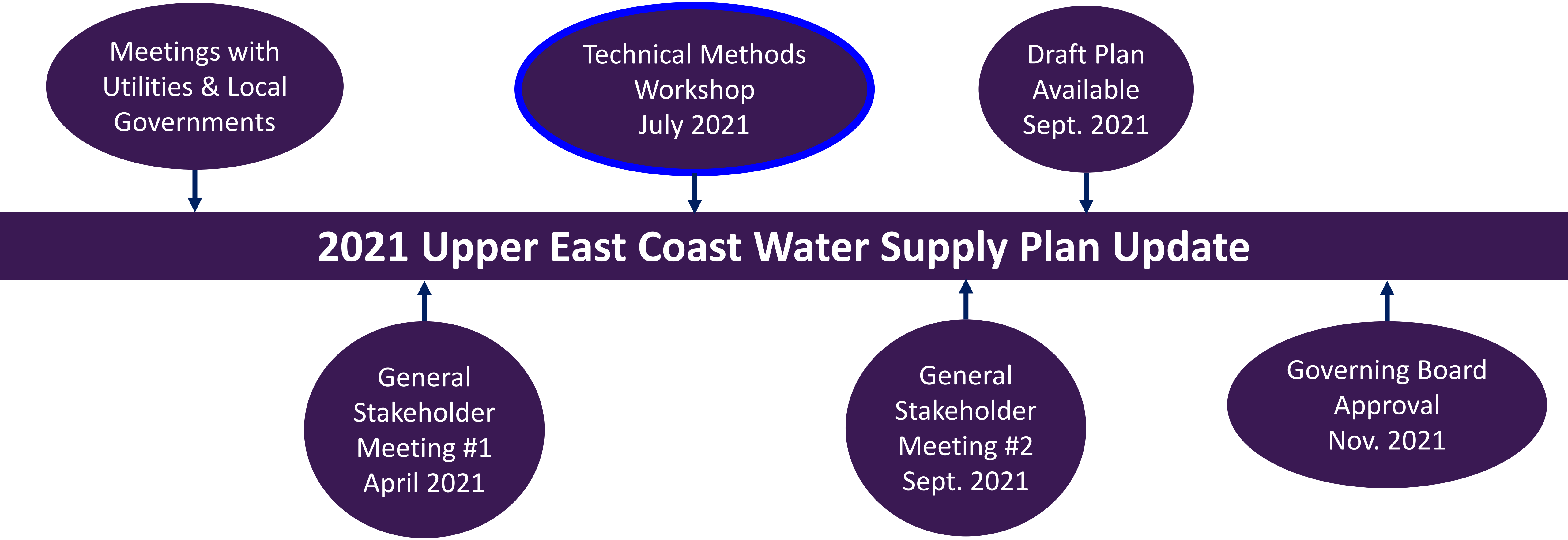
Next Steps

Nancy Demonstranti, P.G.

Upper East Coast Plan Manager

South Florida Water Management District

UEC Water Supply Plan Update Process



Meetings with Utilities & Local Governments

General Stakeholder Meeting #1
April 2021

Technical Methods Workshop
July 2021

Draft Plan Available
Sept. 2021

General Stakeholder Meeting #2
Sept. 2021

Governing Board Approval
Nov. 2021

2021 Upper East Coast Water Supply Plan Update

Thank You